

Multiband photometer CE318-T

User's Manual (rev. January 2018)

Dear Customer and users,

You have just purchased a Cimel photometer CE318-T and we would like to thank you. The CE318-T is the most recent model of the well-known Cimel CE318 photometer. This new model is available and recommended to all users that intend to operate it in the framework of AERONET.

As of today, the usual CE318-N model remains recommended to users that are not affiliated to AERONET.

We have placed in this instrument all our passion and know-how so that it best meets your needs. Innovation and performance: we designed it so that it is always easy to use.

In the line of Cimel products, you will also find a wide range of remote sensing instruments like the Cimel LiDAR CE370 and CE376 automatic aerosol LiDARs.

Of course, in an ongoing effort to satisfy your demands as best as possible concerning our products, our after-sales service department is at your disposal and ready to listen and answer to all your questions and suggestions (contact information at the end of this booklet).

Please visit our website at www.cimel.fr: you will find all our products, as well as additional and useful information.

As part of our commitment to constantly improve our products, we reserve the right to make changes to their technical, functional and/or esthetical properties in line with their technological development.

Caution: Before installing and using your instrument, please read carefully this guide, which will help you to quickly familiarize yourself with its operation. Please read also carefully the preventive maintenance that has to be done weekly and yearly on the CE318-T.

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1 Product overview

1.1. *Presentation*

This high-precision photometer for observing networks measures the optical properties of the atmosphere especially by measuring on one hand, the sun and moon irradiance and on the other hand the sea, soil and sky radiance. It provides the quantification and physical-optical characterizations of the aerosols.

Due to its very low power consumption thanks to the MicroAmps® technology, to its self-powered system and to its rugged design, the CE318-T fully meets the operational requirements of continuous monitoring in terms of reliability, long lifetime and very low maintenance cost.

The CE318-T photometer technology is constantly enhanced to match the new technological challenges for climate observation and monitoring. Cimel's photometers are the benchmark devices for most aerosol observing networks and more specifically for the international federation of AERONET.

The large range of parameters that are derived and calculated from the measurements and from the atmospheric physics equations make the CE318-T photometer a worldwide benchmark device for the following applications:

- Characterization and quantification of aerosols
- Satellite calibration of aerosol measurements
- Detection of volcanic ashes plumes in real time
- Determination of Aerosol Optical Depth
- Determination of fine mode and coarse mode AODs
- Determination of the optical properties of the atmosphere for satellite imaging
- Determination of the ocean's colour
- Determination of the amount of precipitable water vapour
- Air quality monitoring
- Volume size distribution
- Nature of aerosols

1.2. System components quick description

The photometer system is delivered with:

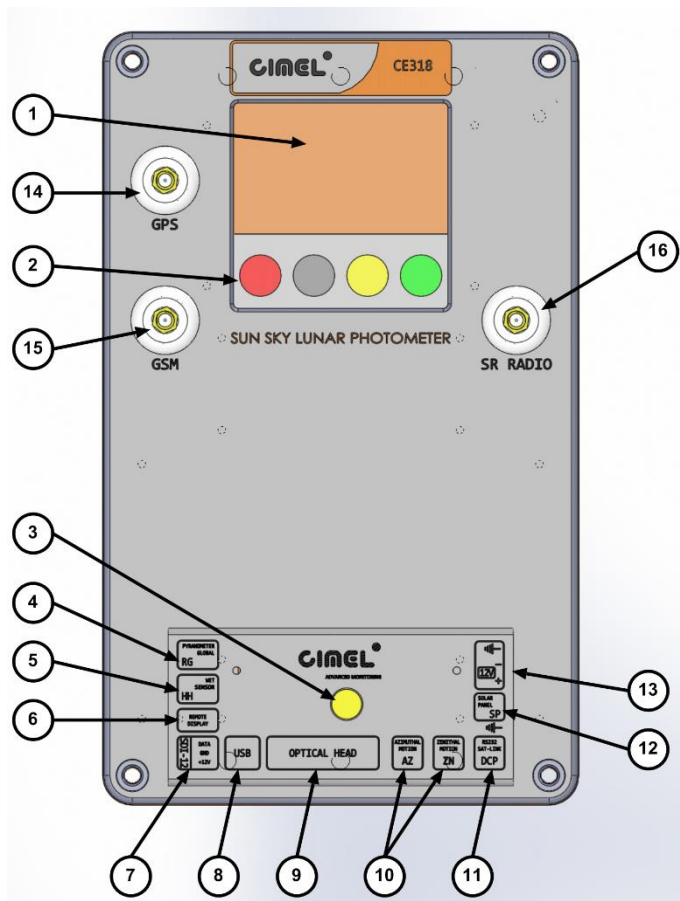
1. Control Unit (CU)

The Control Unit is the component that received all the data acquired by the optical head and it is used as the user interface to parameterize the whole system running.

The CU can transmit the data using different communication protocol (see part 1.4).

The CU gets four keys, a yellow push button and a screen display which enable the users to navigate through the menus.

The features and the menus are described more precisely in **chapter 3**.



User interface:

- 1: Graphic display.
- 2: Capacitive keys.
- 3: Mechanical push button.

Removable terminal block:

- 4: Pyranometer.
- 5: Wet sensor.
- 6: Remote display.
- 7: SDI12.
- 8: USB.
- 9: Sensor head.
- 10: Robot azimuth and zenith motion.
- 11: DCP / Serial communication.
- 12: Solar panel.
- 13: External battery.

Other:

- 14: GPS antenna.
- 15: GSM antenna. *
- 16: Short range radio antenna.*

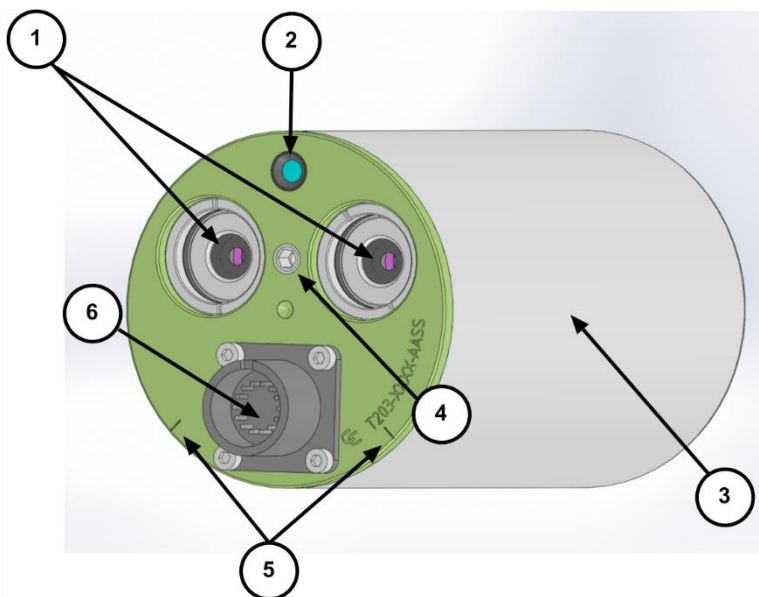
*: Firmware for GSM and short range radio transmissions will be available in 2015.

2. Sensor head and collimator

a. The sensor head

The sensor head measures the received signal from the sun, sky, soil or sea. Then it is sent and recorded to the CU.

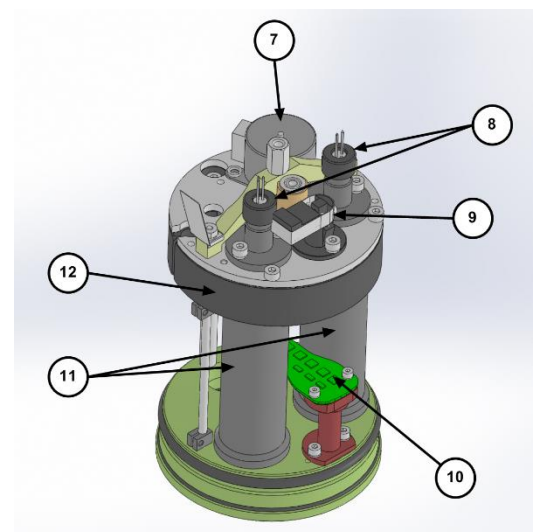
Detectors can be either silicon and InGaAs or silicon only for the SEAPRISM sensor head type. InGaAs detector is used for near-infrared wavelengths.



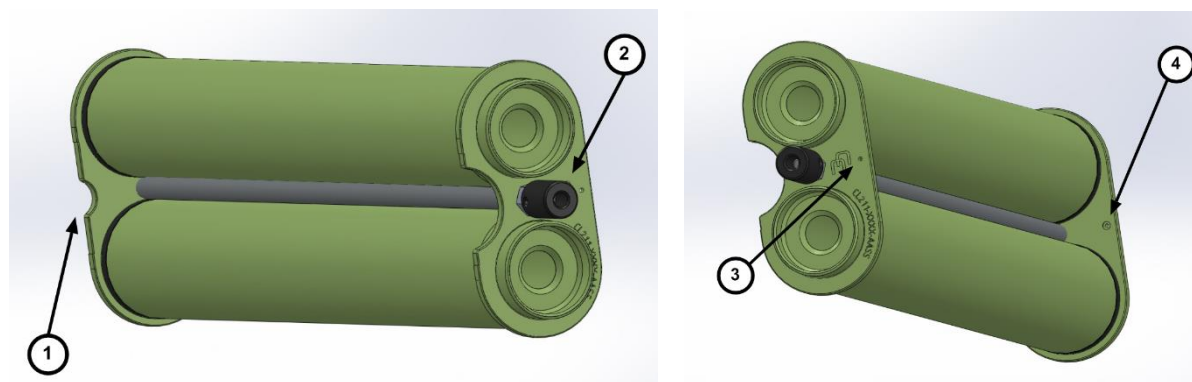
- 1: Front plate lenses and optical chambers entrance
- 2: 4 quadrant detector lens
- 3: Cover
- 4: Threaded hole for collimator
- 5: Positioning notches
- 6: Head sensor cord connector

b. Collimator

The collimator is a component that enables the light to be guided correctly to the sensor head outside lenses. The collimator helps to reduce the stray light.



- 7: Step by step motor
- 8: Detectors
- 9: Filter wheel detector
- 10: 4 quadrant
- 11: Optical chambers
- 12: Filter wheel carter

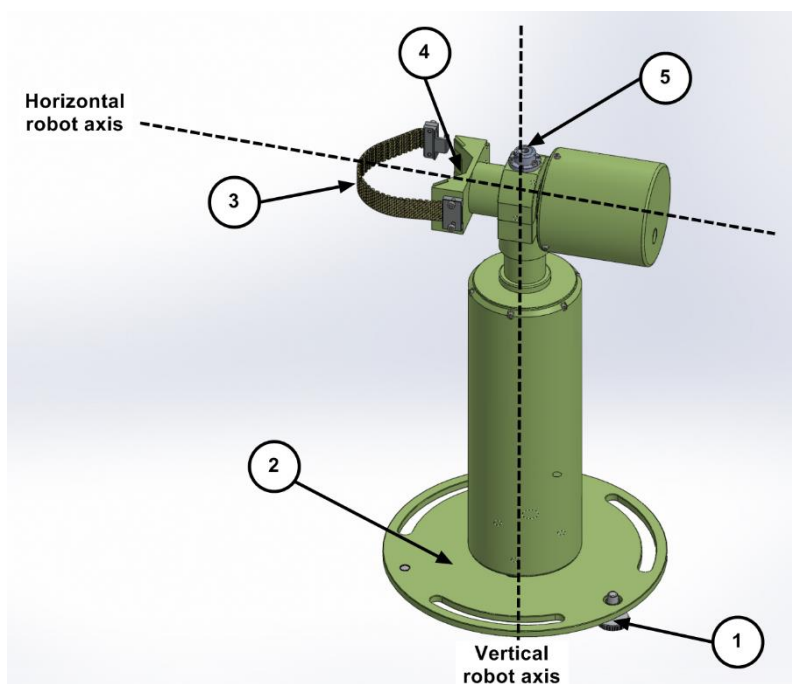


1: notch 2: tightening screw 3: alignment hole 4: spot

3. Robot

The robot is the component on which the sensor head is attached. Its mechanical design enables it to point on whole directions of the sky on the azimuthal and polar (zenith) angles with a very high accuracy.

It is controlled through 2 cables (with RJ11 connectors), one for each axis.

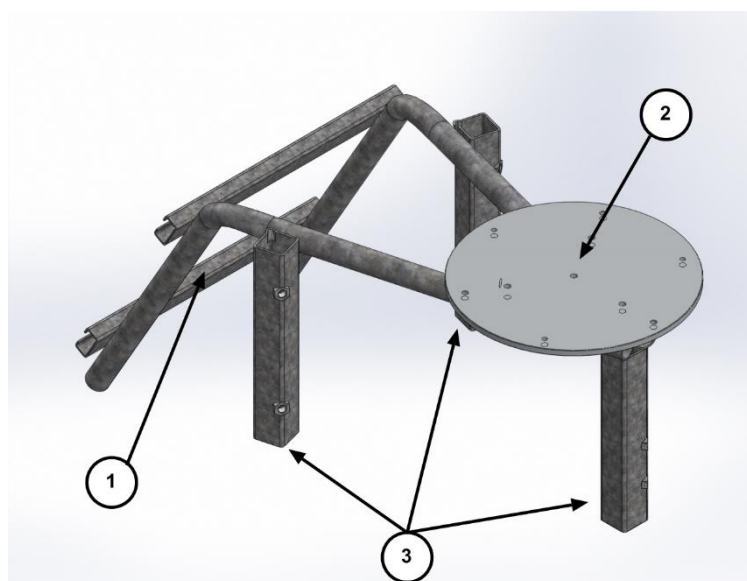


1: adjustment wheel (X2)
2: robot base
3: strap
4: V-shaped part and positioning notches
5: spirit level

4. Tripod and tray

The tripod is the supplied infrastructure where the protection case and the robot are fixed and that enables the whole system to be stably fixed on the ground.

The tray is a part fixed horizontally on the tripod and where the robot will be fixed on.



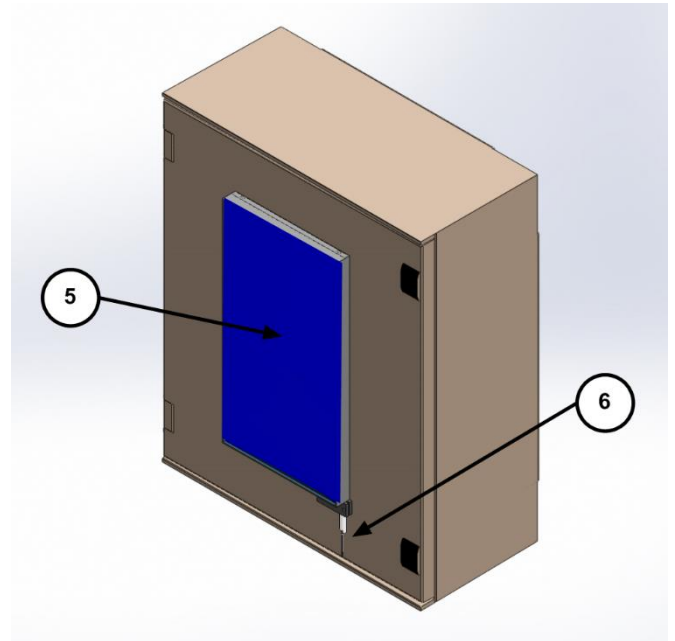
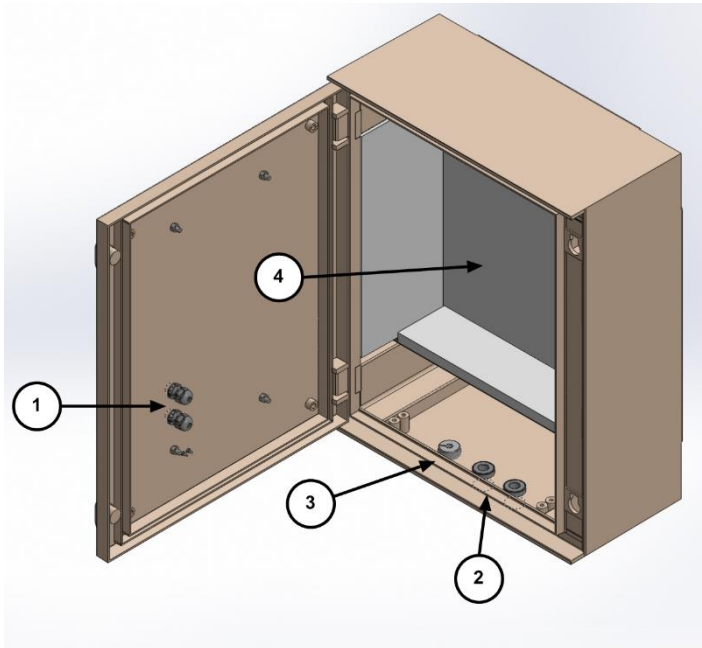
1: emplacement for the protection case

2: tray

3: tripod feet

5. Protection case with solar panel

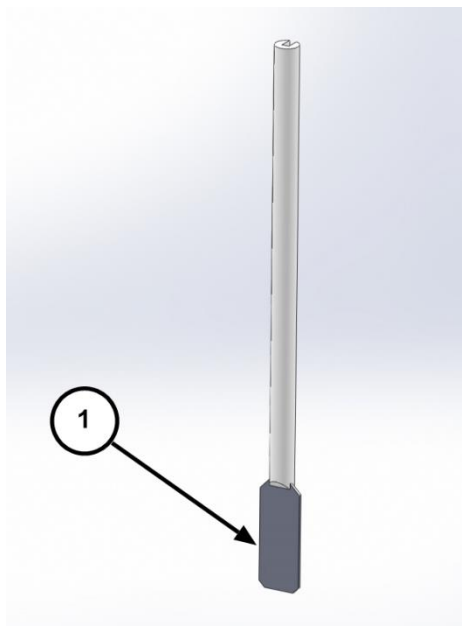
The case is the component where the CU and the pair of batteries are placed. The solar panel that powers the system is incorporated in the case. The output plug of the solar panel is a RJ11 connector.



- 1: Cable gland. The wet sensor and solar panel wires will go through.
- 2: Cable gland. The robot and computer wires will go through
- 3: Cap. The sensor head cord will go through
- 4: Foam
- 5: Solar Panel
- 6: Wet sensor

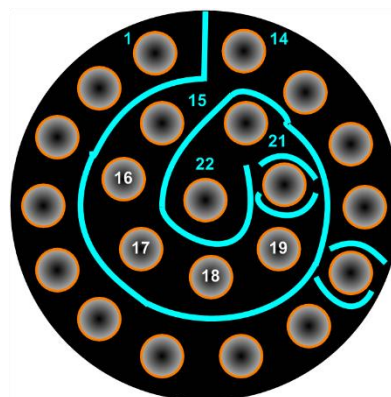
6. Wet sensor

The wet sensor detects rain in order to stop measurements and protect the sensor head from water when it is raining. The output plug of the sensor is a RJ11 connector. Standard length of the wire is 3m.



7. Sensor head cord

The sensor head cord connects the CU and the sensor head. The standard length is 3 meters. One side connector is DB15 (male) type and this other side is Jupiter type with 22 pins (female)



8. Batteries and charger

The black batteries supply power to the CU. The battery is 8AH.

The YUASA battery is furnished when the satellite transmitter is used. The battery is 24AH.

The Mascot 2240 battery charger is used only in case of solar panel breakdown.

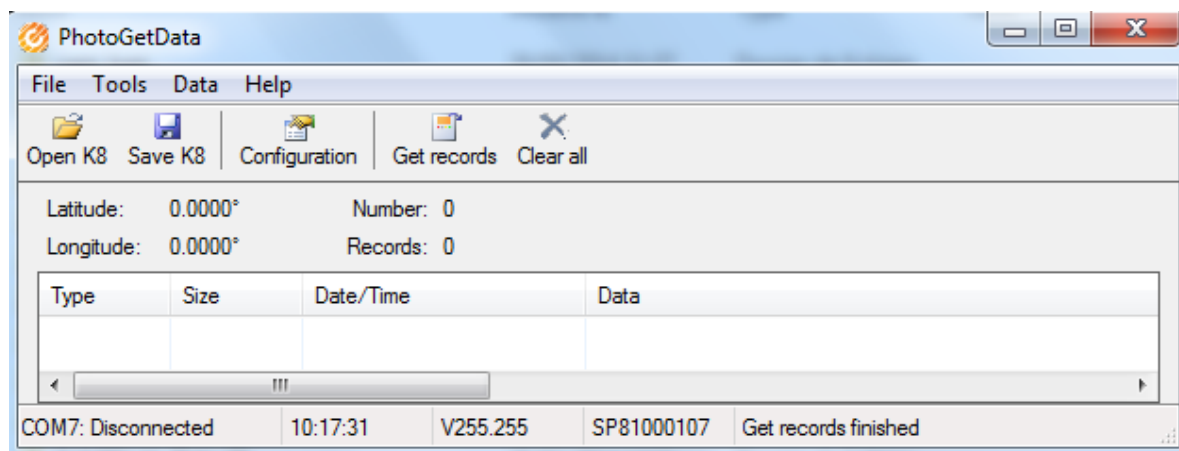


9. Fly case



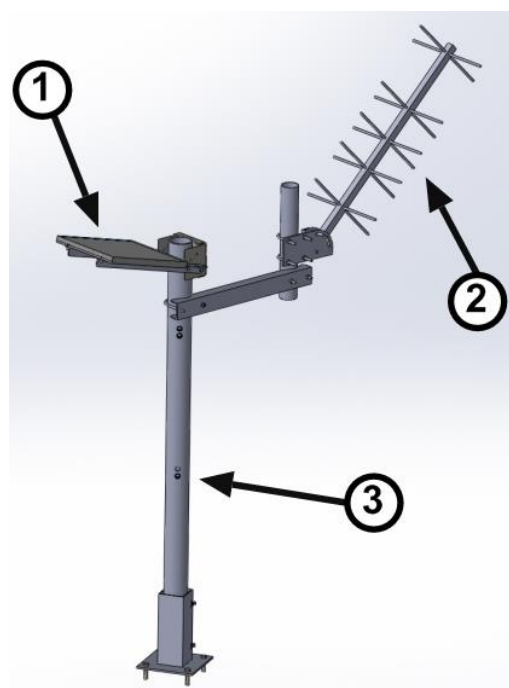
10. PhotoGetData software

PhotoGetData is the software used to communicate from the acquisition PC to the CU. PhotoGetData is not needed when using data transfer by satellite communication protocol. Read the associated documentation delivered with the photometer.



11. Satellite transmitter (optional)

The satellite transmitter is useful in remote places where no reliable PC is available. It enables to send the data directly to an appropriate geostationary satellite which has a dedicated transmission channel for the CIMEL photometers.



- 1: Solar Panel Solartek
- 2: YAGI antenna
- 3: Mast

1.3. *Sensor head types*

5 different sensor head types exist:

- **Standard:** It uses 340, 380, 440, 500, 675, 870, 937, 1020 and 1640 nm filters
- **Polarized:** A filter wheel containing 3 sets of 3 polarizers operating in infrared (POL1), Ultraviolet (POL2), and visible (POL3) and which are orientated with a 120° angles is added on top of the wheel containing the Standard filters. Additional information about the aerosols nature and shapes can then be retrieved.
- **Seaprism:** It is designed for Ocean Colour application. It uses only silicon detectors. It uses 412, 440, 500, 531, 550, 675, 870, 937, 1020 nm filters.
- **BRDF:** it uses 380, 440, 550, 675, 740, 870, 937, 1020 and 1640 nm filters
- **BRDF 12 filters:** It is designed for satellite calibration. It uses 412, 440, 500, 555, 675, 702, 740, 782, 870, 937, 1020, 1640 nm filters.

The sensor head types differs in the presence of an additional wheel filter containing polarisers for the Polarized type, the filters wavelengths mounted in the head sensor, the and the scenario sequence established.

Filters wavelengths are defined in the UV-visible-IR spectrum according to scientific retrieval purposes.

The filters and polarizers curves are delivered with the photometer.

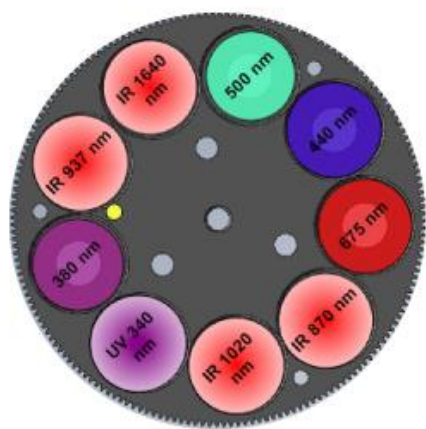


Figure 3: STANDARD type

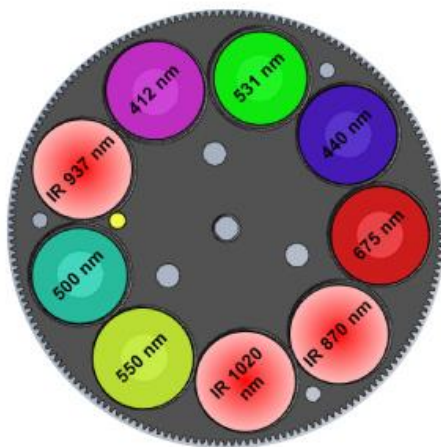


Figure 2: SEAPRISM type

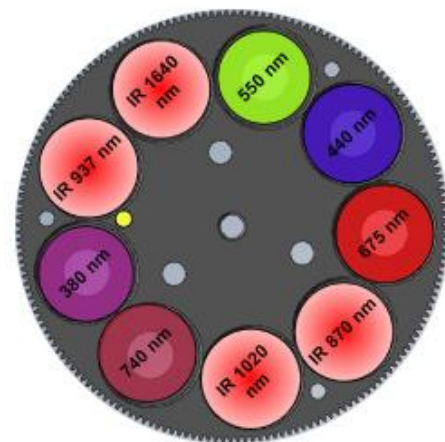


Figure 1: BRDF type

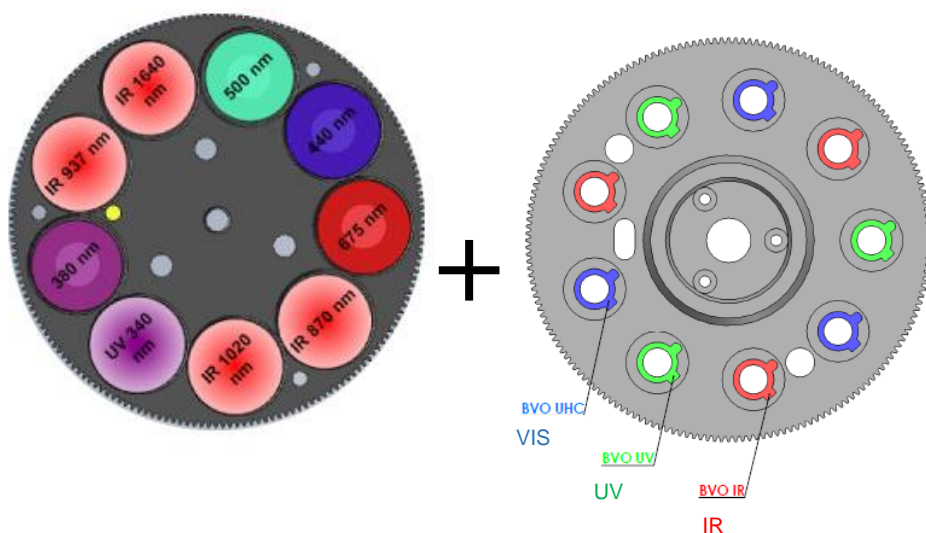
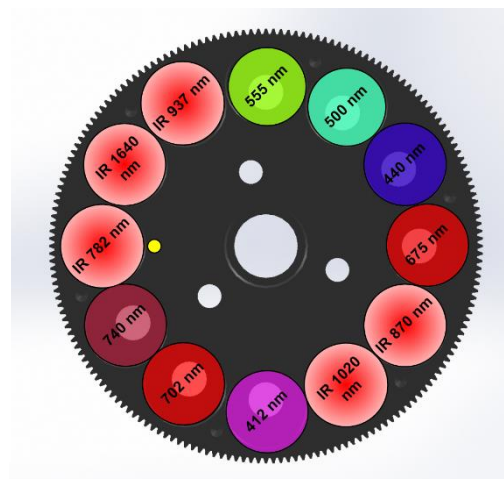


Figure 5: POLARISED type



1.4. *Data transmission*

The photometer can use 3 different communication protocols to send its data from the CU.

- PC data transfer using a RS232 link to an acquisition PC. (Default data transmission). The PC is not provided.

- Satellite data transfer using a DCP transmitter module. The proper way to set the module is explained in the Installation chapter.
- USB link for punctual connections

2 Installation

2.1. *Installation site recommendations*

The site should be chosen carefully in order to comply with the following conditions:

- Easy access to facilitate the weekly maintenance of the device.
- The device should be installed in a clear area where it has the largest possible field of view so that it can track the sun from sunrise to sunset (no buildings, trees, cables...).
- Less than 100m cable distance to a PC (for RS232 link connection).
- A support where it can be strongly fixed so that the system is stable (preferably the tripod).

2.2. *Hardware installation and setup*

In this description, notions on how to manually control the photometer via the CU are necessary, it is recommended to read **chapter 3 and 4** to have a better overview of what is done when installing the system.

However the following instructions are detailed enough so that it is not mandatory to read the 2 chapters cited above.

If the tripod system is not used, skip to part 2.2.4.

2.2.1. Needed tools

To install the system, the following tools are needed:

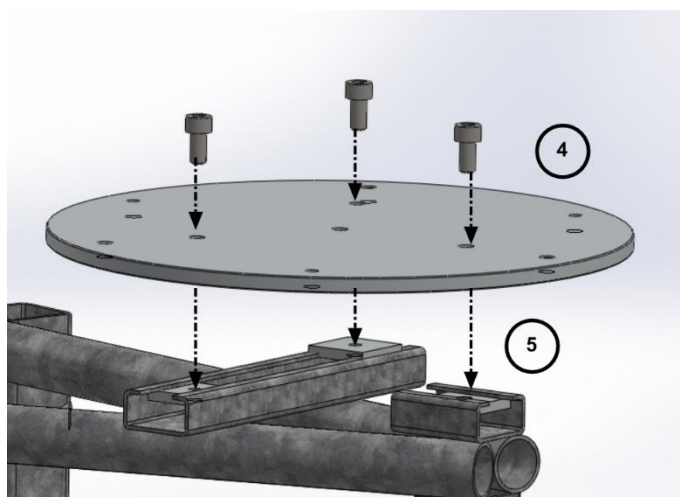
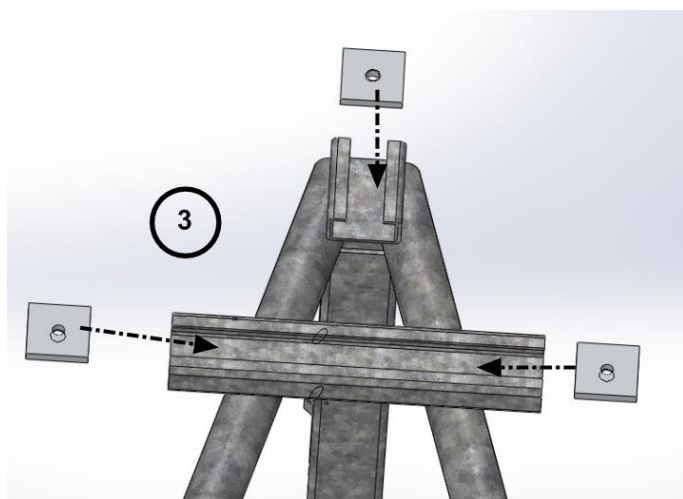
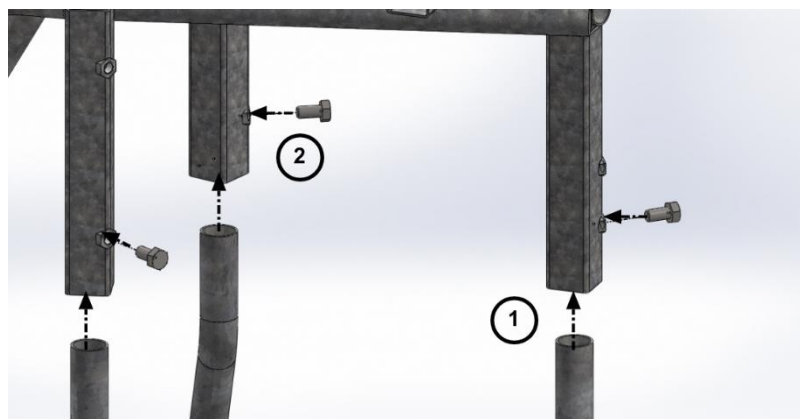
- Open-end wrench size 10.
- Open wrench size 13.

If possible, a tubular spirit level will be used in addition of the robot spirit level to make the installation easier (0.4mm/m accuracy).

2.2.2. Tripod mounting

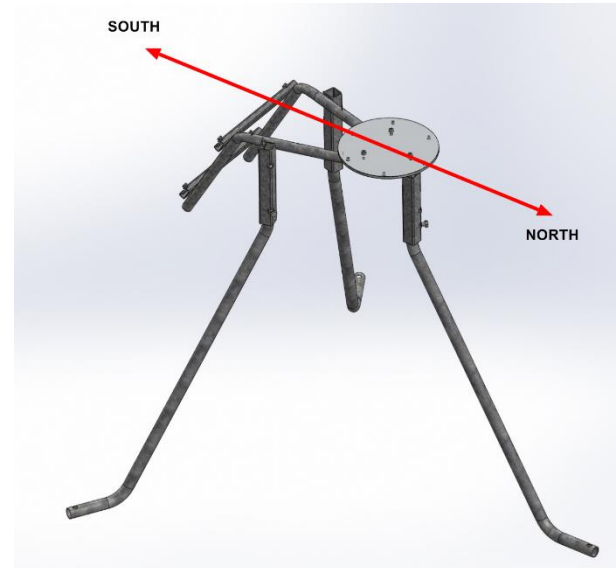
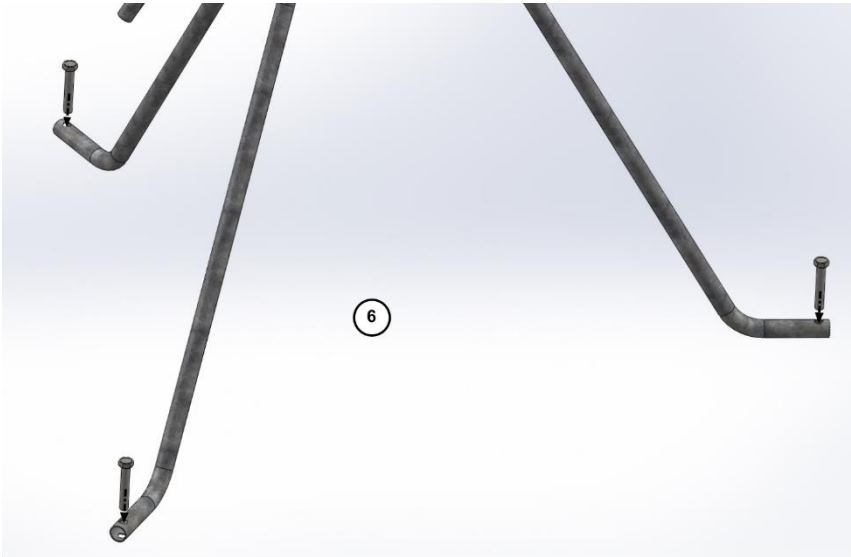
The tripod mounting system is designed for easy installation of the photometers in most site conditions.

1. Insert the three photometer tripod feet into the metallic frame.
2. Tight the 3 screws on the tripod feet.
3. Insert the ribs into the slides designed for this.
4. Insert the screw into the tray.
5. Tight strongly the screw into the rib with the tray in between.



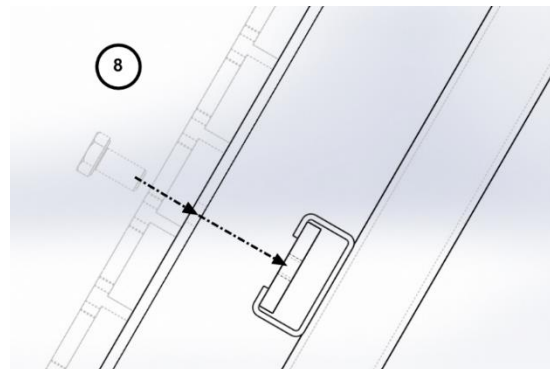
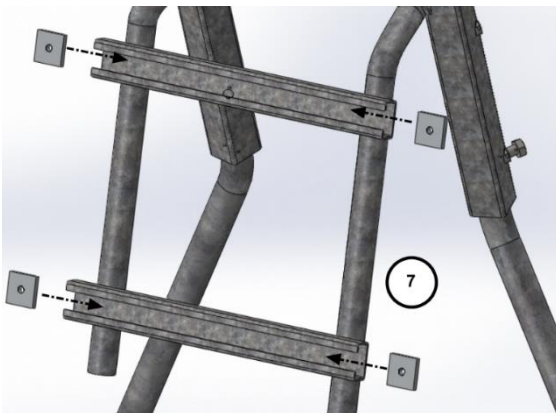
6. Attach the tripod feet to the ground with appropriate screws.

Note: Orientate the protection case emplacement South if the location is in the Northern hemisphere or North if the location is in the Southern Hemisphere.

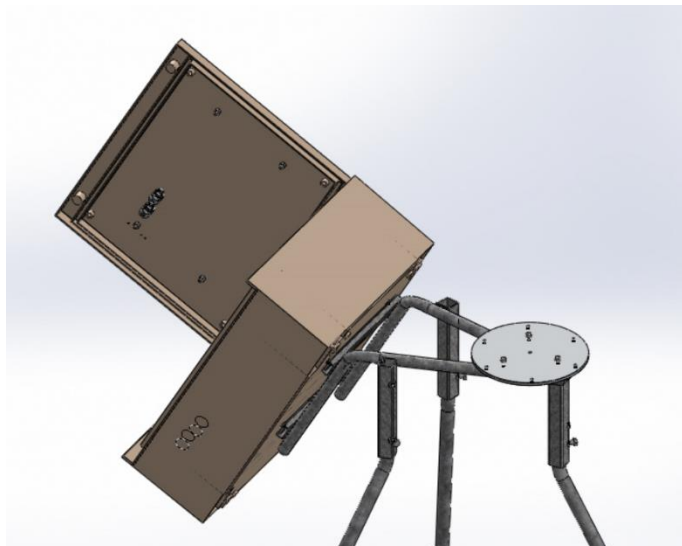
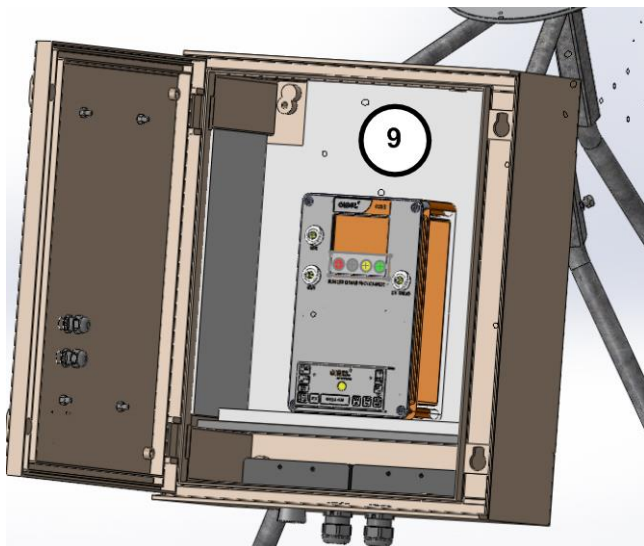


2.2.3. Case mounting

7. Insert the 4 ribs into the metallic frame in order to fix the case.
8. Tight strongly the screw into the ribs with the inside of the case in between.

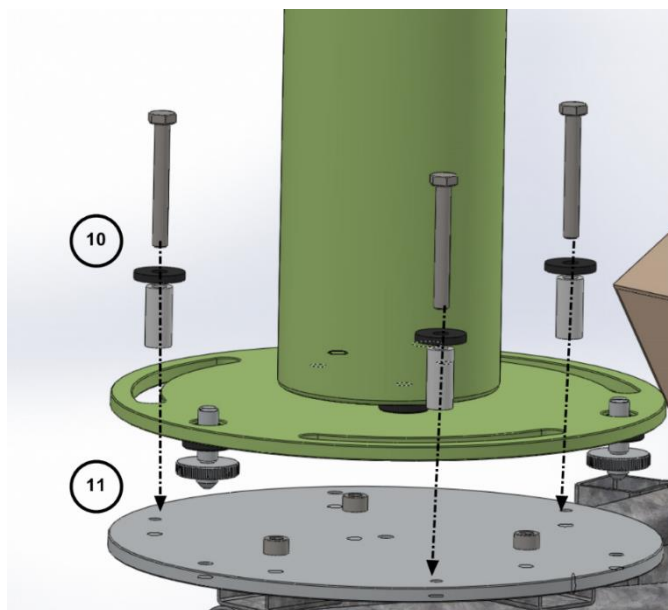


9. Put the foam at the bottom of the case and on the sides, place the batteries and the CU as shown on the picture below.



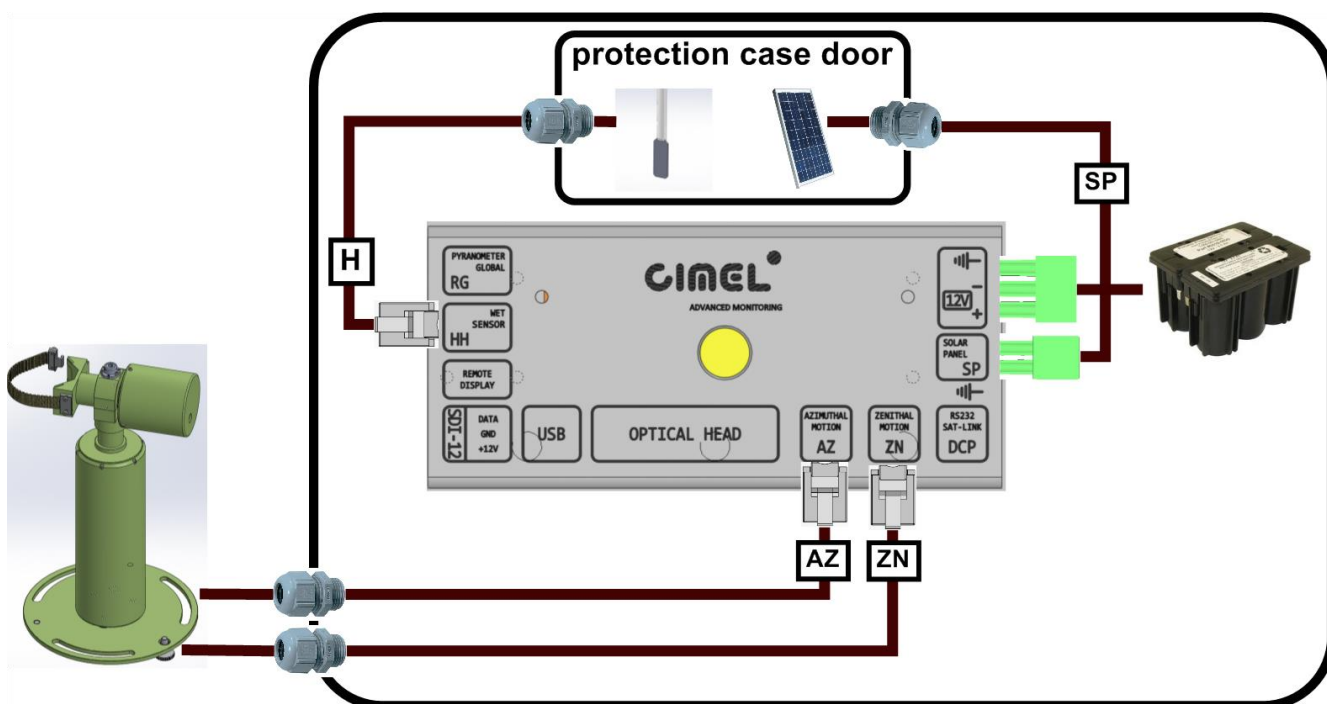
2.2.4. Robot and sensor head mounting

10. Put the screws into white plastic part.
11. Put the screws on the holes through the robot base but don't tight them to the end, let a 2 or 3 cm backlash so that the levelling that is done in the next part is easier to do.

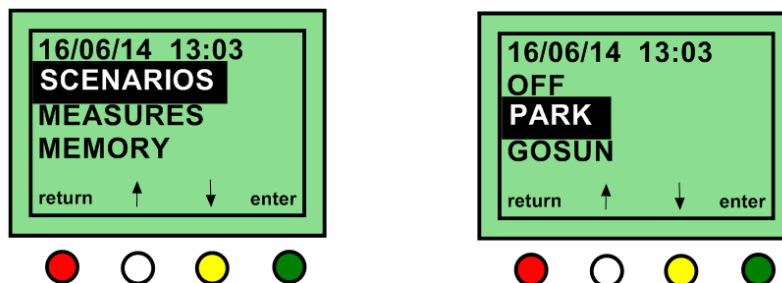


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12. Connect AZ (robot AZimuthal motor), ZN (robot Polar motor), solar panel, and wet sensor and battery wires to the removable terminal block of the CU passing them going through the cable glands of the protection case.

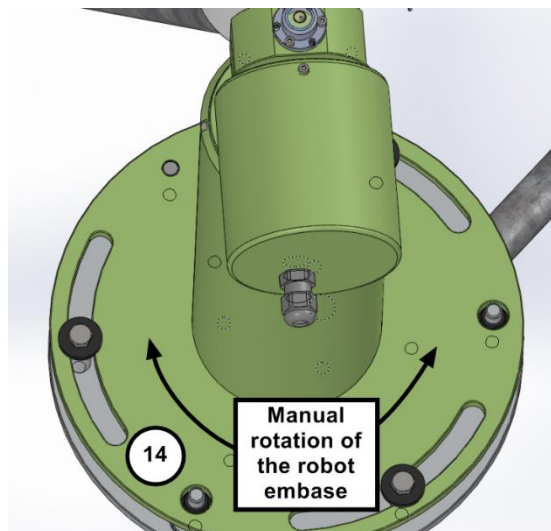
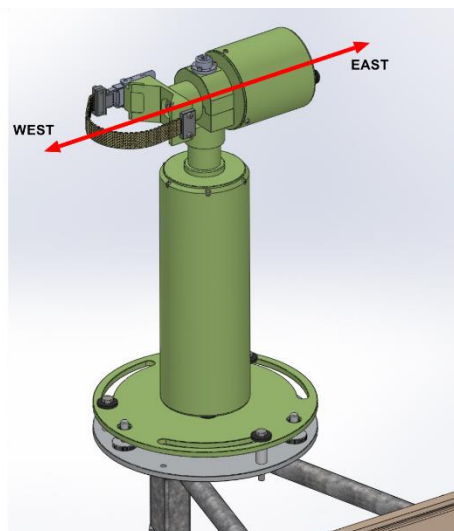


13. Launch a Park scenario in the CU menu. The robot will find its zero position.

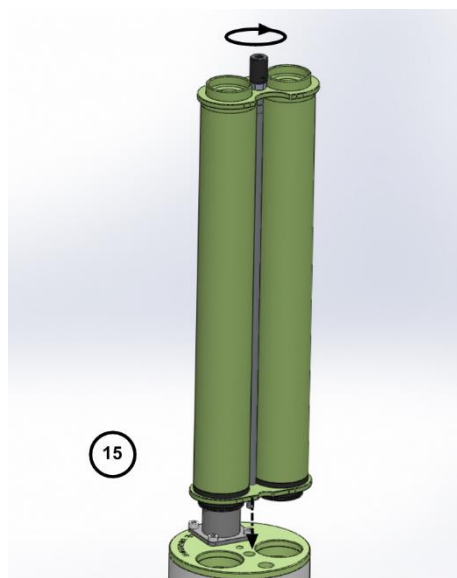


Select SCENARIOS then PARK and validate with the green button

14. Set the horizontal robot axis in the East-West direction by manually turning the whole base of the robot.

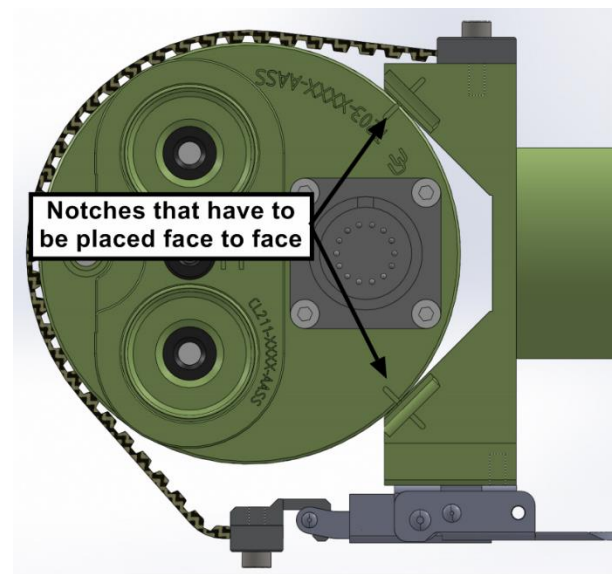
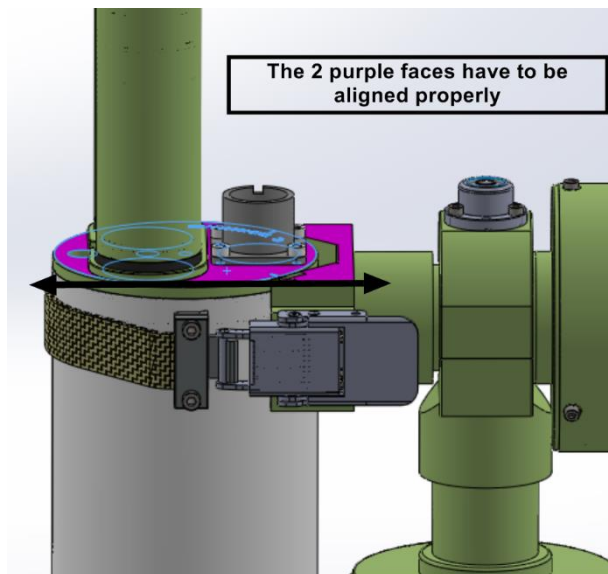
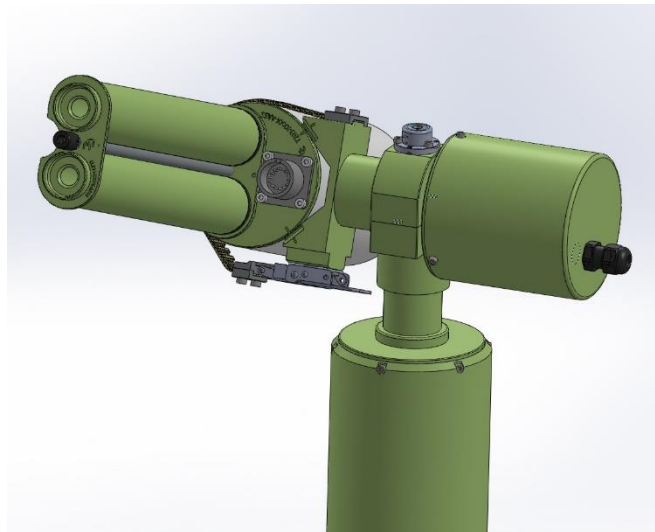


15. Assemble the collimator to the sensor head front plates by tightening strongly the long central threaded rod using a plier. The notch must face the 4 quadrants lens on the sensor head front plate.



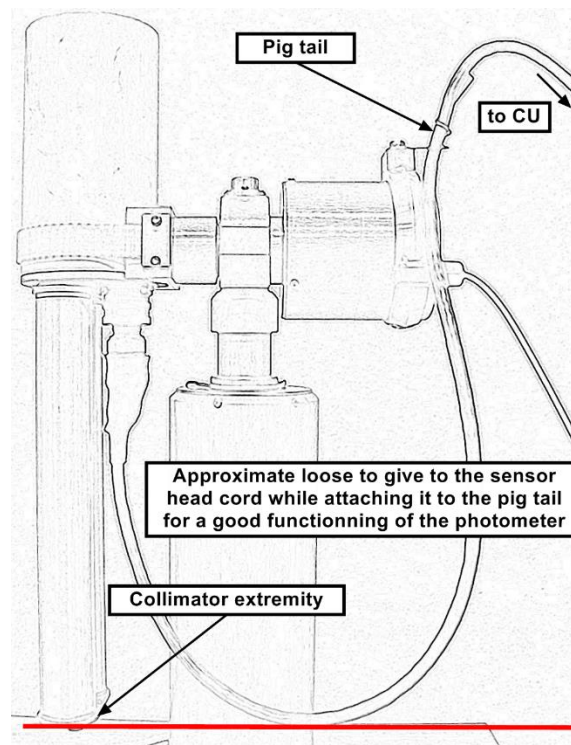
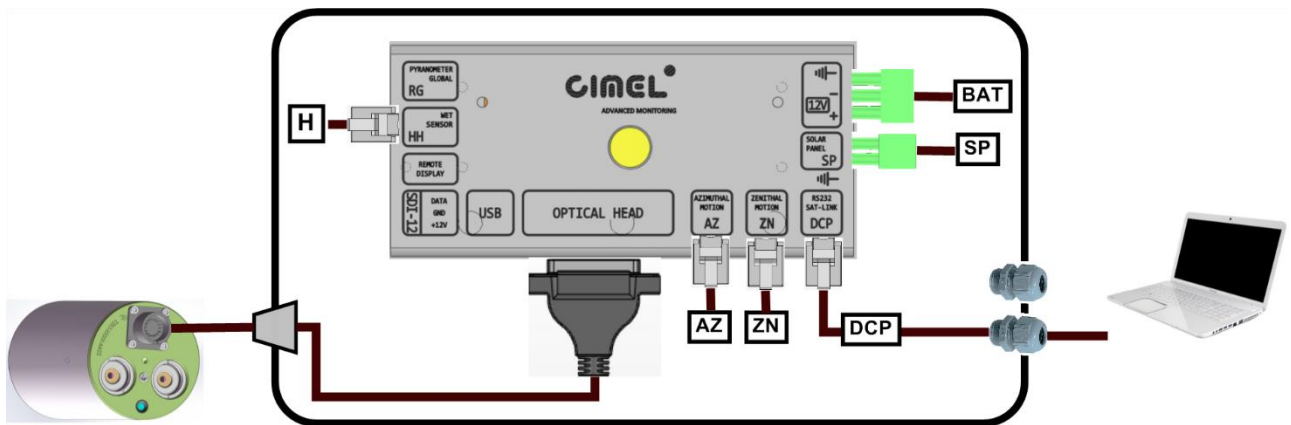
Note: Watch out that the collimator and the sensor head are completely interdependent. There should be no slack while trying to move the collimator after having tightened it.

16. Strap the sensor head on the V-shaped support of the robot. Two things are to be checked. First align the sensor head front plate with the upper surface of the V-shaped support. Then use the notches present both on the robot and the sensor head as a visual indicator to position the sensor head correctly. Notches have to be aligned.

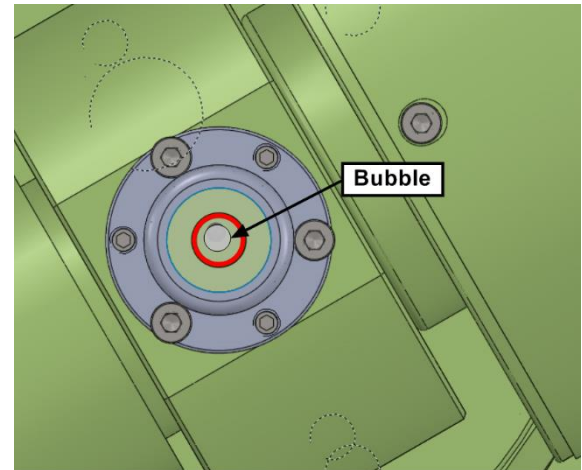
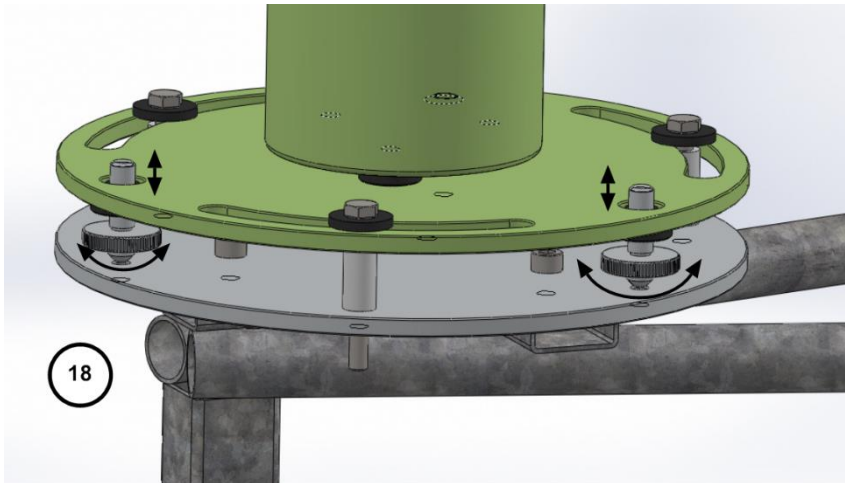


17. Plug the sensor head cord from the CU to the sensor head passing it through the cap and attaching it to the pig tail. Connect the computer or the transmitter to the DCP input on the removable terminal block via a RS232 to RJ11 cable.

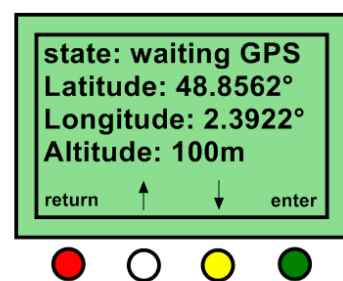
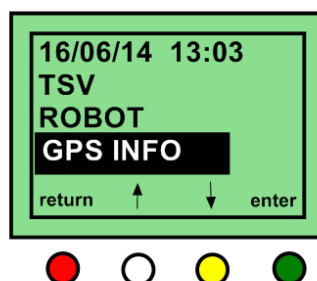
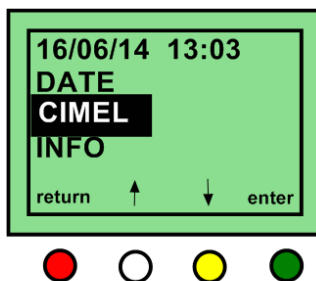
Note: A slack has to be maintained so that the head sensor cord will not be too much extended while the device is operating, which can lead to the malfunctioning of the photometer.



- 18.** Level the robot up so that it's perfectly horizontal by playing on both precision wheels until the spirit level on the top of the robot is centred. This part is a little tricky and may take few trials. Using an additional tubular spirit level may facilitate this step.



- 19.** Set coordinates, UT time and date using the following menu. Wait maximum 15 min for automatic GPS synchronization. When done the coordinates will be displayed on the screen.

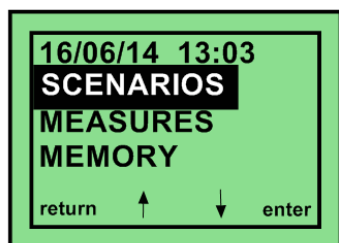


Select CIMEL then GPS INFO and validate with the green button

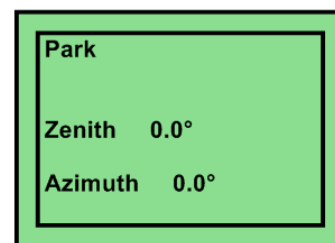
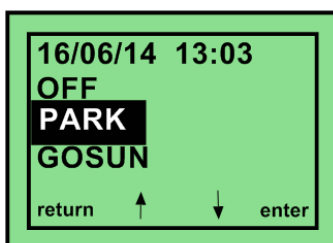
- 20.** Launch a Park scenario in the CU menu. The photometer head will find its PARK position which is the nadir on the polar angle (head orientated down).

If the head is pointing to zenith (orientated up), unstrap the sensor head, reposition it in the opposite sense in the straps and do step 13 again.

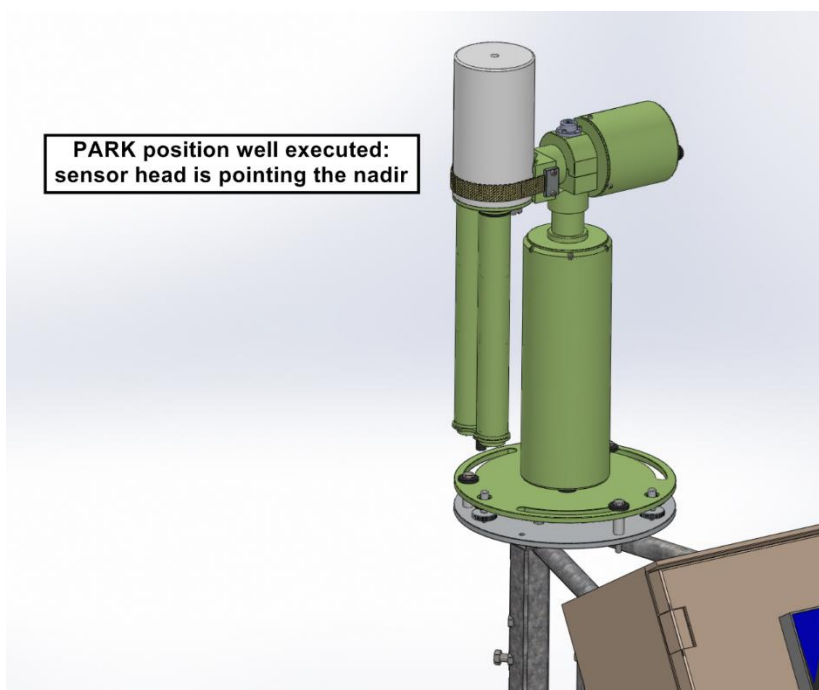
Note: Place the spirit level on the robot V-shaped part after the PARK scenario. It should be perfectly horizontal, if not refer to part 5.2.2.



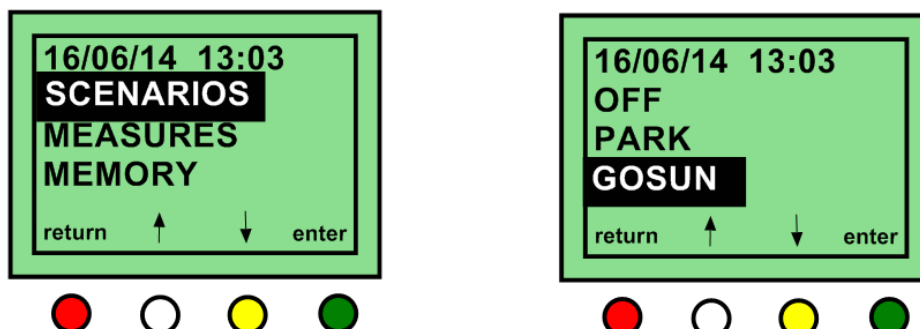
Select SCENARIOS then PARK and validate with the green button



Screen displayed after a PARK

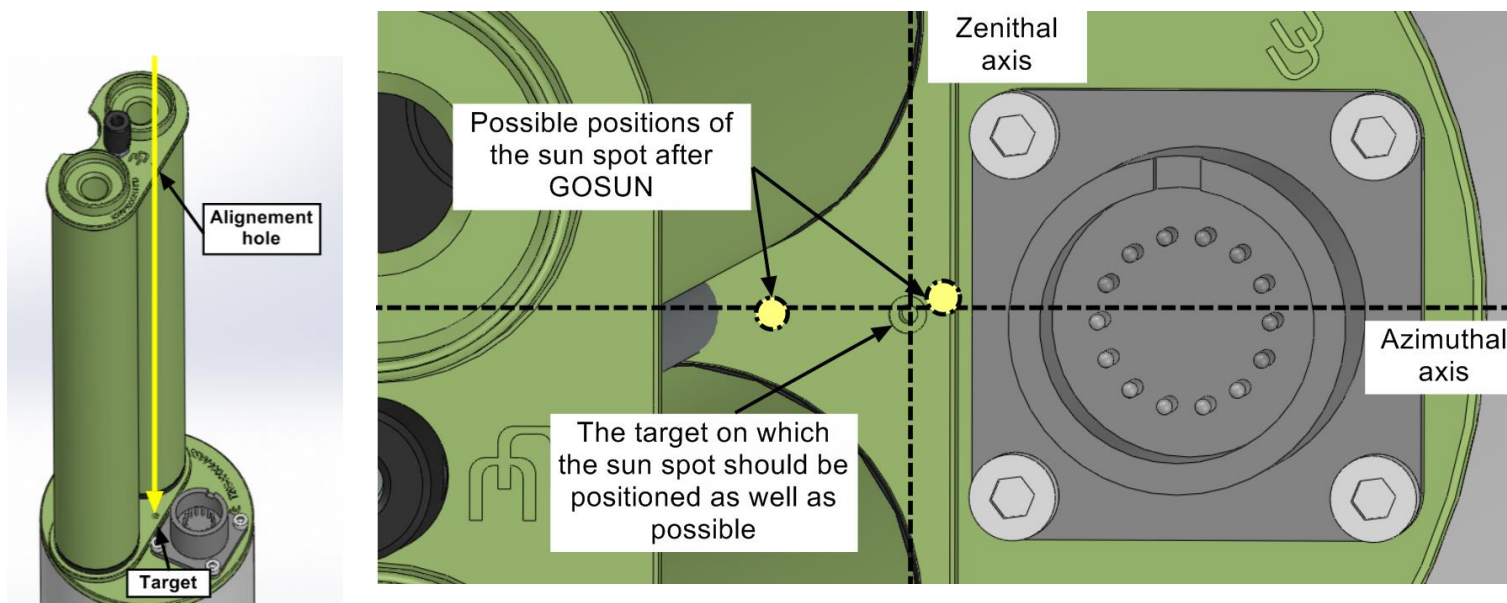


21. Launch a GoSun scenario in the CU menu. The sensor head is going to point the sun. Polar and Azimuthal values are displayed in degree on the CU screen.



Select **SCENARIOS** then **GOSUN** and validate with the green button

After a GOSUN scenario the sun spot may not be centred on the target.



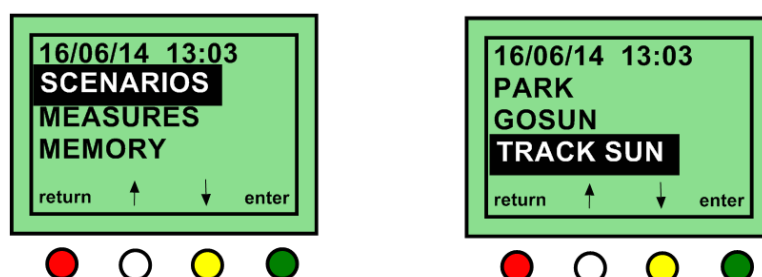
The GPS coordinates, UT time and date being received automatically from the satellite, the error on the polar axis should be inferior to 1 mm as long as the spirit level is well centred (If superior refer to part 5.2.2).

If not centred on the azimuthal axis, refine the manual positioning of the robot base as done in step 14. (The screws being loosened the base can still be moved).

After having done the corrections, repeat steps 20 and 21 to check again the position of the sun spot. Repeat the correction until the sun spot is almost perfectly centred on the target (few millimetres off maximum).

Note: The centring error will be compensated by the 4 quadrant sensor in the TRACK process described in the next step.

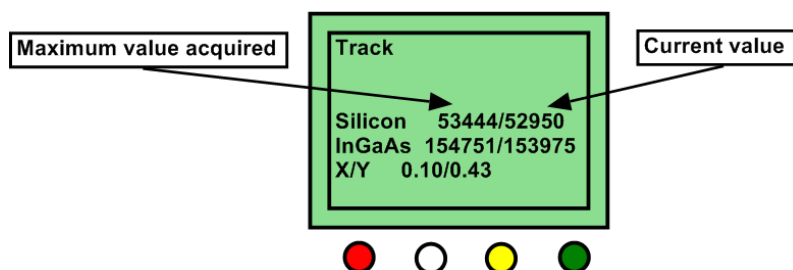
- 22.** Launch a TRACK SUN scenario in the CU menu. The robot will follow the sun move. Check that the sun spot is centred on the collimator spot at the end of the scenario. If a problem occurs, please read part 5.3.2.



Select SCENARIOS then TRACK SUN and validate with the green button

Using a 4 quadrant sensor, the TRACK SUN scenario is guiding the robot to the point where the intensity of the signal on both Silicon and InGaAs channel is the highest.

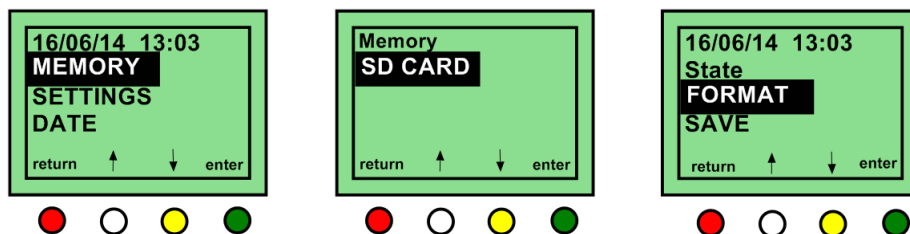
This intensity is corresponding to the centre of the sun.



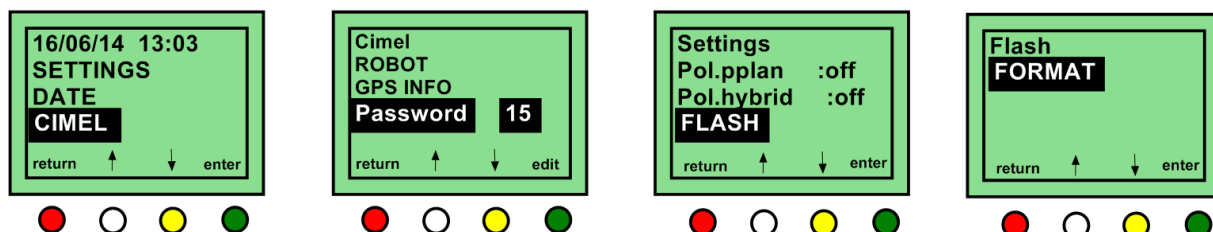
- 23.** When the track is done correctly, repeat step 20, 21 and 22 once or twice to validate the photometer behaviour.
- 24.** Tight the screws into the tray to fix the robot without changing its position.

Important note: watch out that the level didn't move. If the level moved, go back to step 18 and after repeat step 20, 21, 22.

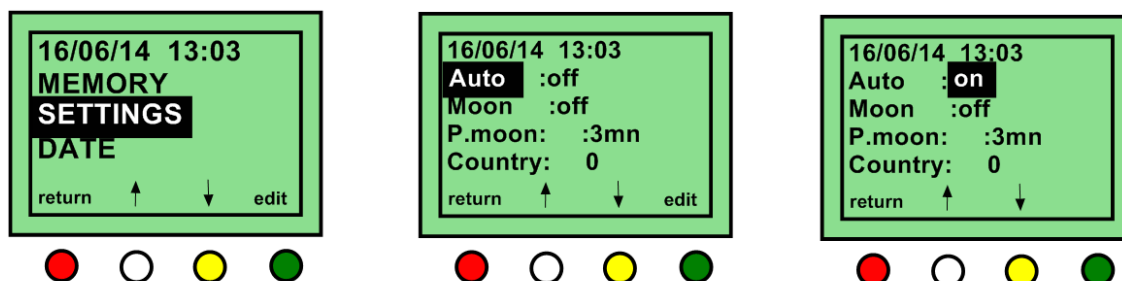
25. Format the SD card and the flash memory.



Select MEMORY, SD CARD, FORMAT and press green button twice to validate



Select CIMEL, set Password to 15, press twice return to get in the hidden Settings menu, select FLASH, then FORMAT and validate with the green button



Select SETTINGS then Auto and switch it to ON

26. Set the photometer in automatic mode.

The photometer installation is finished for the hardware part. We are now going to describe the software installation and configuration for the different mode of communication.

2.3. *Communication protocol installation and setup*

The photometer supports several communication medias.

The USB and the RS232 can be used for local data retrievals, parameter settings and instrument firmware updates. The RS232 is optically isolated and can be used as a permanent connection. The USB connection has to be used only as a temporary connection.

GPRS FTP can be used to upload data to a server.

Satellite transmission can be used to transfer data from isolated sites. In that case, the user needs to get an account from the satellite manager.

2.3.1. RS232 communication

To transfer the data from the CU to a PC via a RS232 link, then follow the steps described below.

2.3.1.1. Software configuration

- Plug the RS232 link to the dedicated PC (already done in installation part)
- Install PhotoGetData on the computer

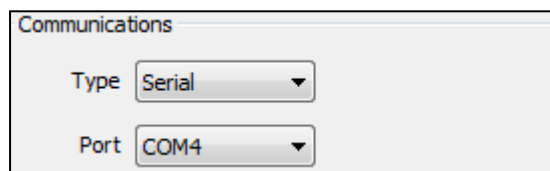
The software is provided on the USB stick or a CD sent with the instrument and can be downloaded on Cimel website.

- Launch PhotoGetData.

In the **tools** → **configuration** menu:

In the *communication tab*:

→ Choose Serial in the communication type and choose the Port COM associated to the photometer.



Note: USB should be used only for punctual data transfer. The backup on the SD card can't be done when the USB link is plugged.

In the *data tab*:

- Tick enable the creation of automatic recording, create K8 and/or create ASCII
- Choose the data saving directory
- Set the time from which the data will be transferred and the frequency of transfer.

- Choose the recording period and the generic file name of the records.

2.3.1.2. Computer configuration

The computer must be configured as follows in order to avoid intervention as much as possible especially in case of power cut by applying the following changes in the PC setup:

- Put PhotoGetdata icon in the Windows start folder
- Remove any password request while starting the computer

Control panel → User account

- If possible, an uninterrupted power supply (UPS) should be installed and the PC bios configured so that it restarts automatically after a power cut. (see with the local pc expert)

For AERONET members, follow AERONET instructions to install the automatic protocol for data transfer to AERONET central system.

2.3.2. USB communication

2.3.2.1. Software configuration

The user should install the USB driver provided by Cimel. (see PhotoGet data manual). Plug the USB cable to the dedicated PC. Install PhotoGetData. The software is provided on the USB stick or a CD sent with the instrument and can be downloaded on Cimel website. Launch PhotoGetData.

In the **tools → configuration** menu:

In the *communication tab*:

→ Choose USB in the communication type photometer.



2.3.3. GPRS – FTP communication

The CE318-T photometer supports GPRS - FTP communication.

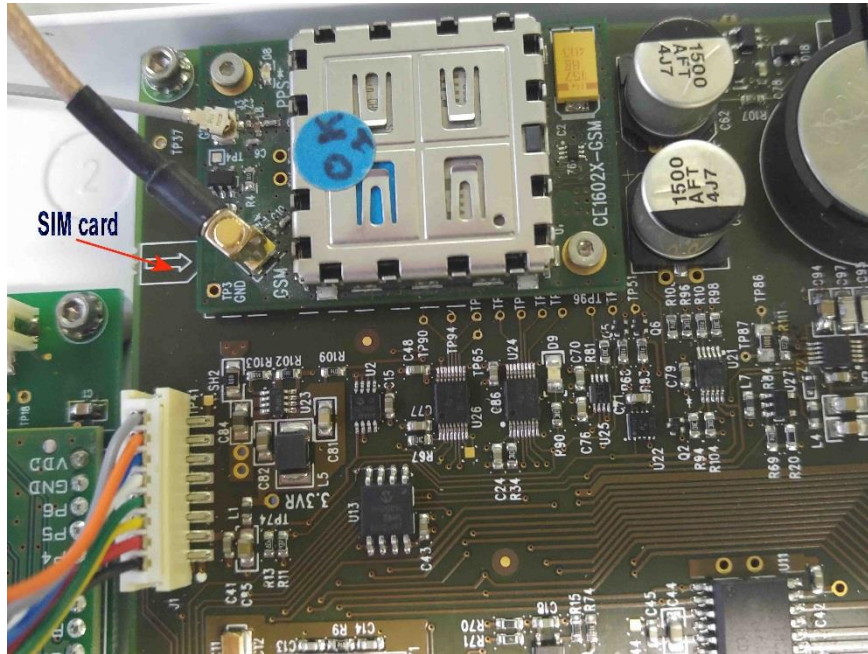
The user must choose a local telecommunication operator, buy a plan with a SIM card with 3G or 4G or WCDMA capability (that includes GPRS transfers) and subscribe a subscription. Standard daily operation requires a data transmission of 20 Mo / month.

The user may use his own FTP server or the AERONET Server. He must enter the user name and password and specify the name of the directory where the data will be uploaded.

If the user is an AERONET member, he should ask the AERONET staff instructions for sending data to the NASA FTP server.

2.3.3.1. Operation

The user inserts the SIM card into the slot provided in the photometer control box.



He should make sure in accordance with the chosen operator that the GPRS coverage is efficient on his field-site.

The photometer initiates the transmission, it automatically connects to Internet on the user's FTP server and uploads the data.

The photometer sends its data to only one single server.

2.3.3.2. Parameters configuration

Some of these settings cannot be edited / modified on the CU. PhotoGetData has to be used to modify them.

In SETTINGS\GSM\GPRS menu

- **APN:** Operator Access Point Name.

In SETTINGS\GSM\GPRS\FTP

- **FTP:** Enable or disable FTP automatic action [OFF; ON]: **OFF**.
- **ADDR:** Address of the FTP server. Maximum length: 32 characters. Default: ""

- **USER:** Username used to login on the FTP server. Maximum length: 32 characters. Default: **"anonymous"**.
- **PASS:** Password for the username. Maximum length: 32 characters. Default: **"guest"**.
- **PORT:** Communication port used to establish the FTP session communication with the FTP server [1; 65535]: **21**.
- **DIR:** Directory where the data are stored on the FTP server. Maximum length: 48 characters. Default: **"/"**.
- **FTP interval:** FTP transmission period. [00:00:00; 23:59:59]: **01:00:00**.
- **FTP offset:** FTP start period. [00:00:00; 23:59:59]: **00:00:00**.

2.3.4. Satellite transmission installation and configuration

The satellite transmission of the data is done using a Satlink 2 logger and transmitter model SL2-G312-1 and a YAGI antenna. The satellite which will receive and transmit the data depends on the geographic location, it can be GOES, MSG... the satellite has dedicated communication channel that can be attributed to the Satlink2.

First of all, to install properly the YAGI antenna, the azimuthal and polar angles corresponding to the satellite the antenna will point to must be known.

The following website enables to get these angles:

http://aeronet.gsfc.nasa.gov/new_web/antenna.html

Choose the satellite the data will be sent to, the registered AERONET site or the coordinates of the photometer's location if not in AERONET database and click apply. (Here is an example for long 3° and lat 45°)

Cimel Parameter and Antenna Tool

Select the Satellite :

☒ GOES EAST
☐ GOES WEST
☐ METEOSAT
☐ GMS

Choose Coordinates or AERONET Site

Coordinates in Decimal Degrees (South and West < 0; North and East > 0):

Longitude
Latitude

Or Existing AERONET Site:

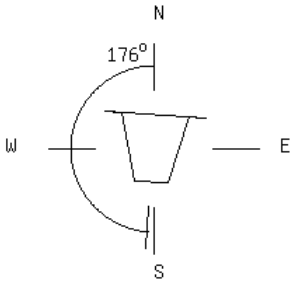
Gosan_SNU
GOT_Seaprim
Gotland
Gozo
Graciosa
Granada
Grand_Forks
Great_Falls
Greenbelt_Park
GSFC

ANTENNA POSITION

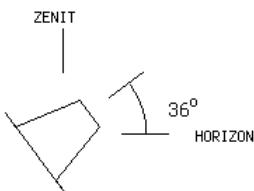
Satellite : METEOSAT

Antenna Latitude = 45.000000
Antenna Longitude = 3.000000

Azimuth Angle :

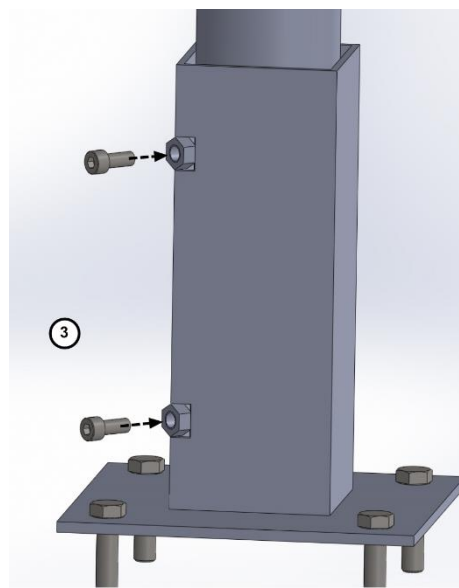
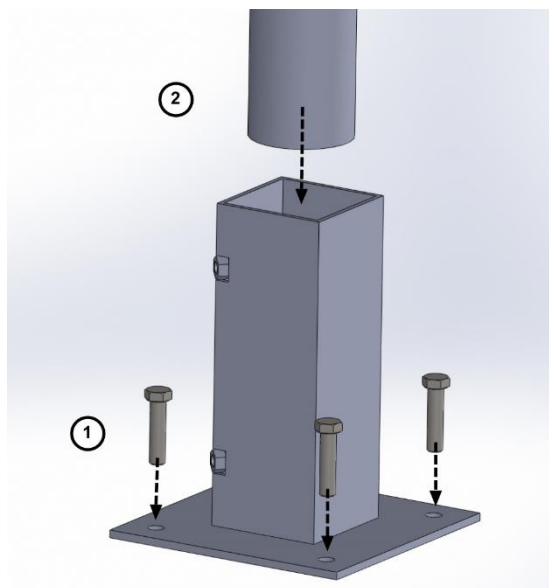


Elevation Angle :

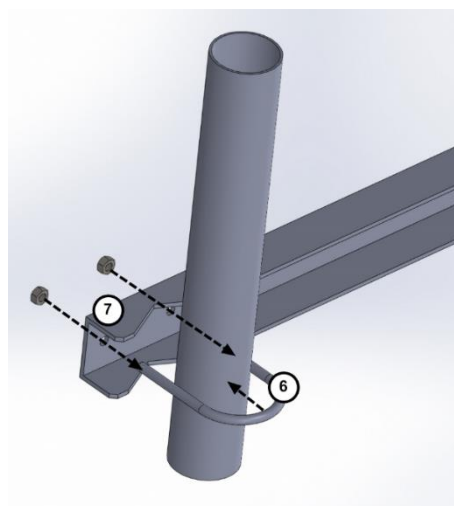
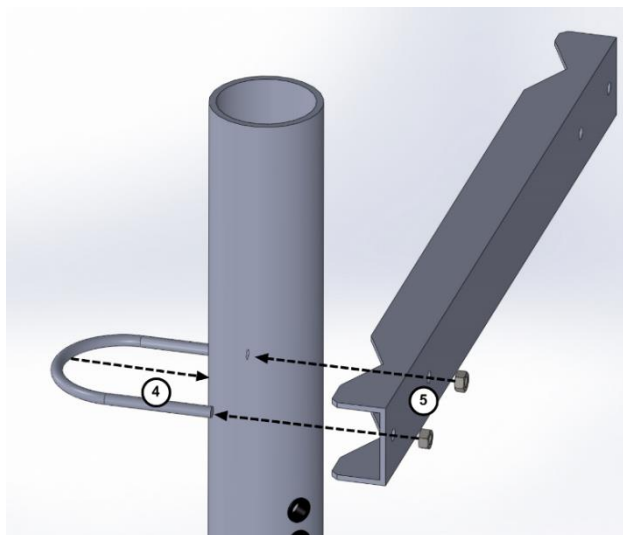


2.3.4.1. Transmitter and antenna installation

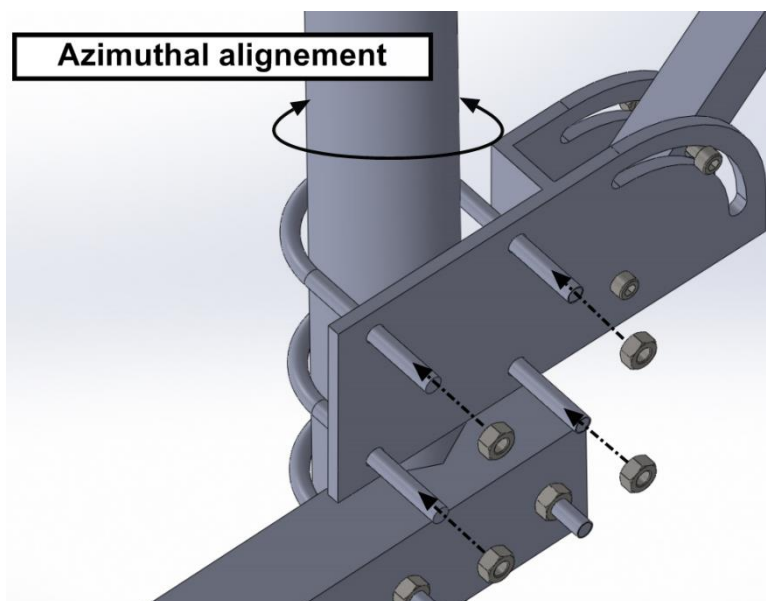
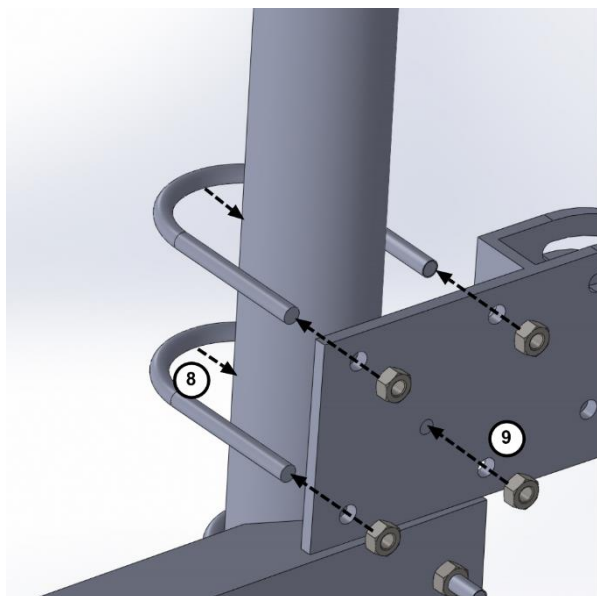
1. Attach the mast support in the ground.
2. Insert the mast into the mast support.
3. Tight the screws to fix properly the mast.



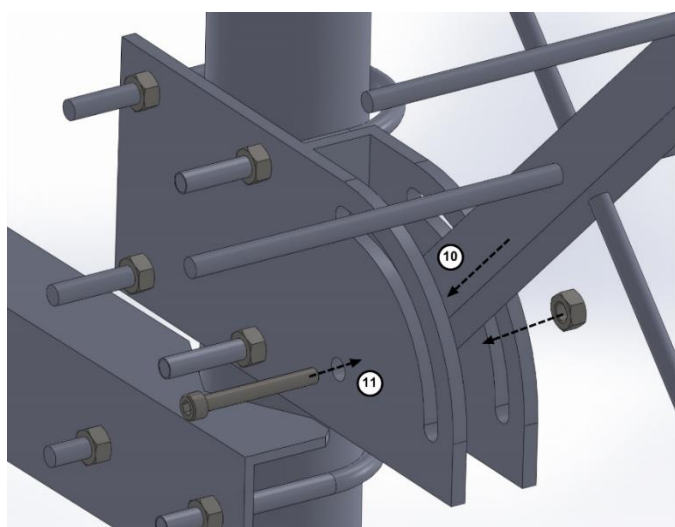
4. Slide the stirrup through the mast until it gets to the end position.
5. Insert the V-shaped part in the stirrup extremities with the mast in between and tight strongly the nuts.
6. Insert the stirrup extremities in the V-shaped part with the tubular metallic part in between to fix it.
7. Tight the 2 nuts.



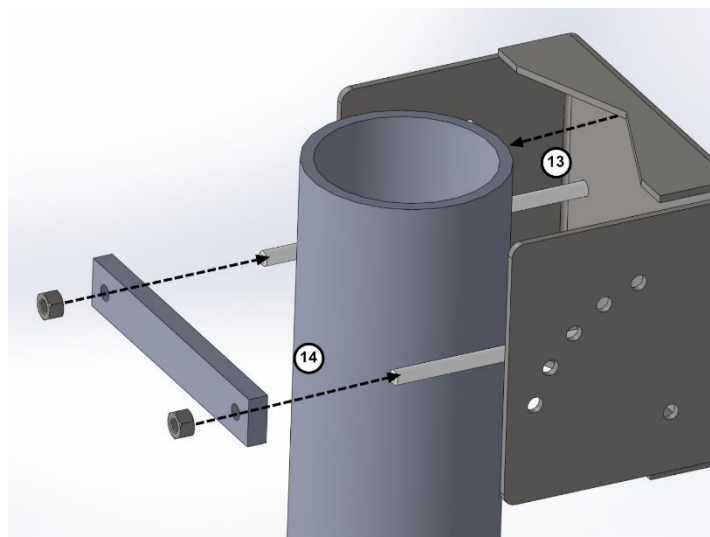
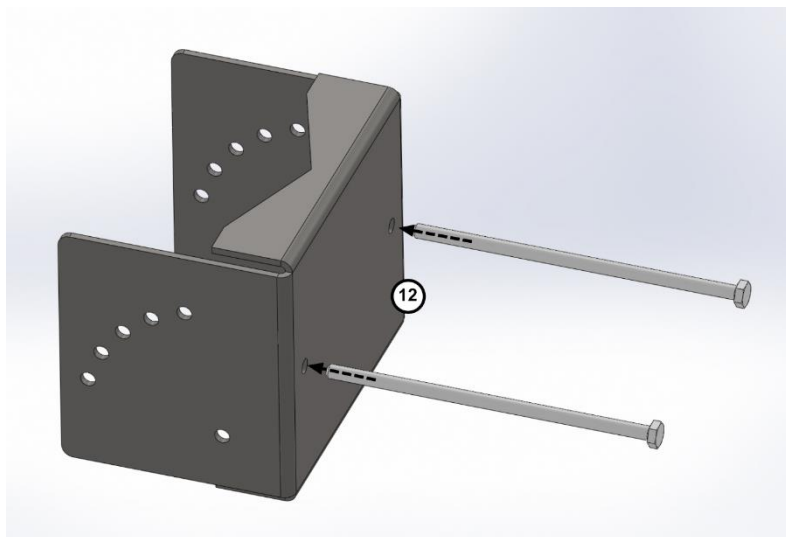
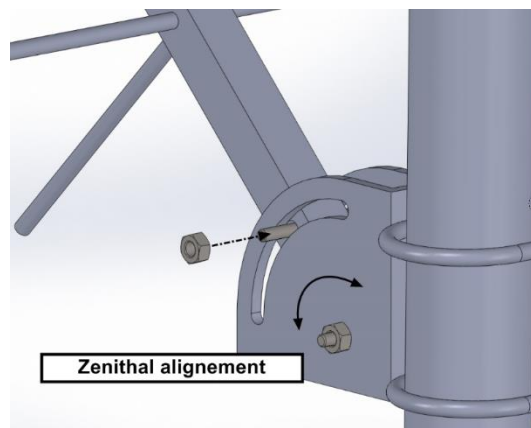
8. Insert the YAGI antenna support in the stirrups with the tubular metallic part in between. Orientate the support to the right angle on the azimuthal plan.
9. Tight the 4 nuts.



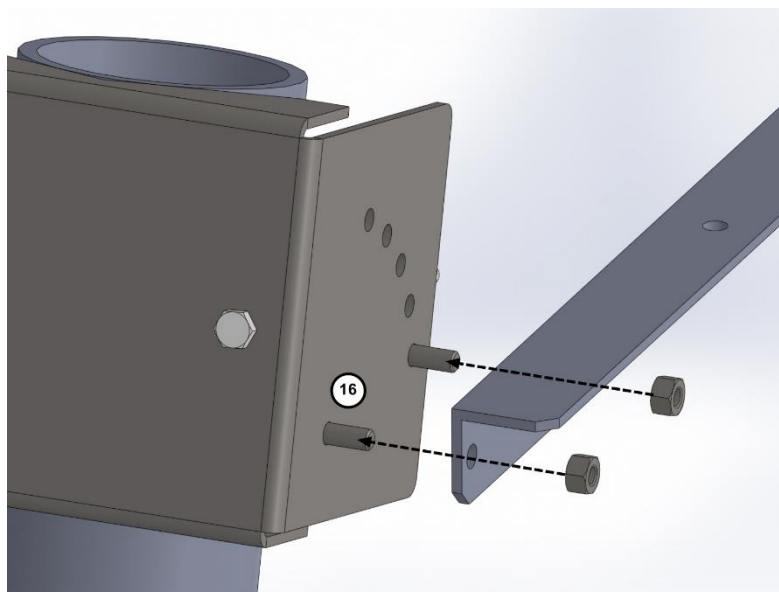
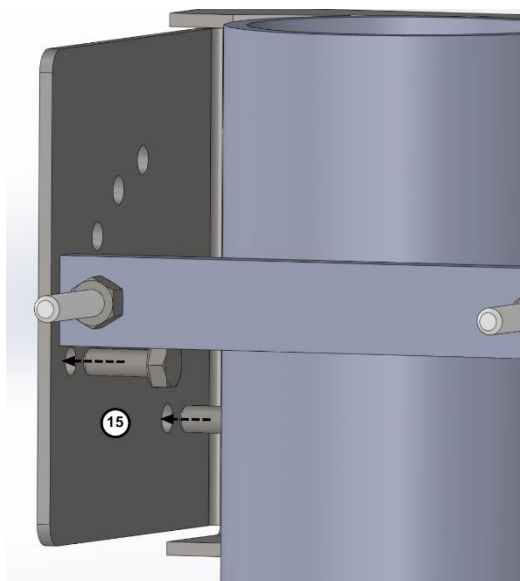
10. Insert the YAGI antenna into its support. Orientate the antenna to the right polar angle.
11. Insert the screw in both the YAGI antenna support and the Antenna and tight the nut to the opposite side.



- 12.** Insert the 2 white screws into the V-shaped part.
- 13.** Put the white screws around the mast.
- 14.** Insert the fixing flats into the white screws until it gets in contact with the mast and tight the 2 nuts.

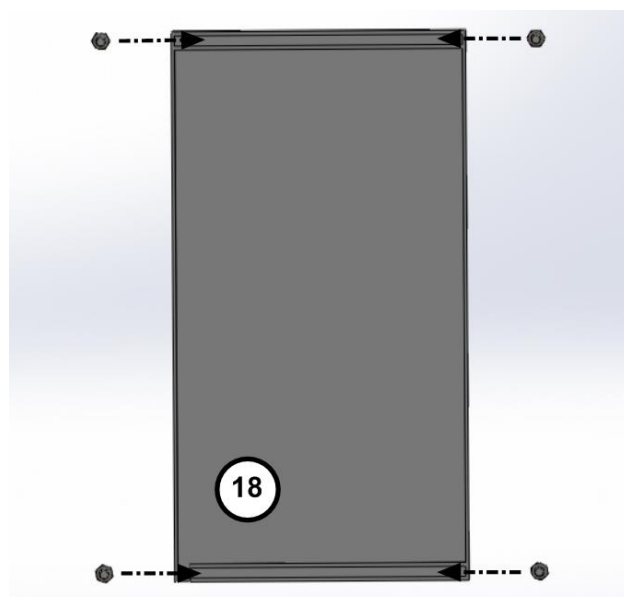
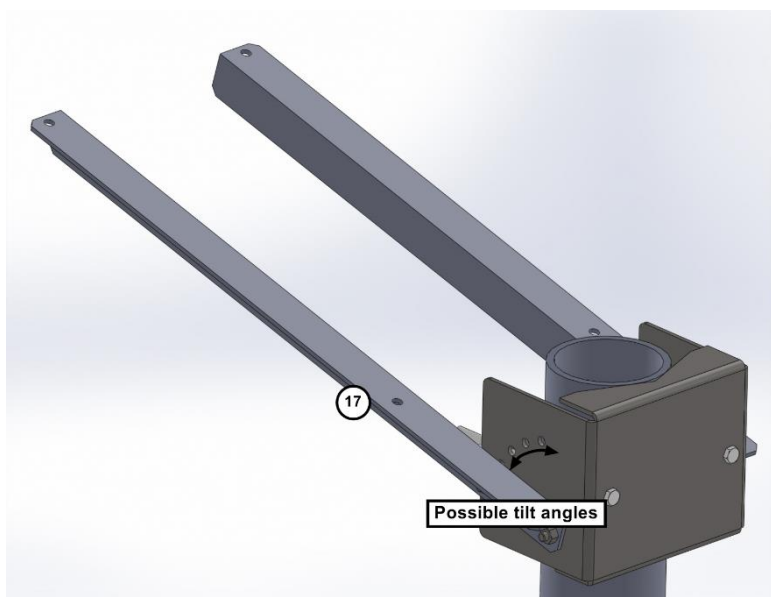


- 15.** Insert the screws in the holes of the V-shaped part according to the tilt angle wished for the solar panel (step 17).
- 16.** Insert the panel brace in the screws and tight the bolts strongly.

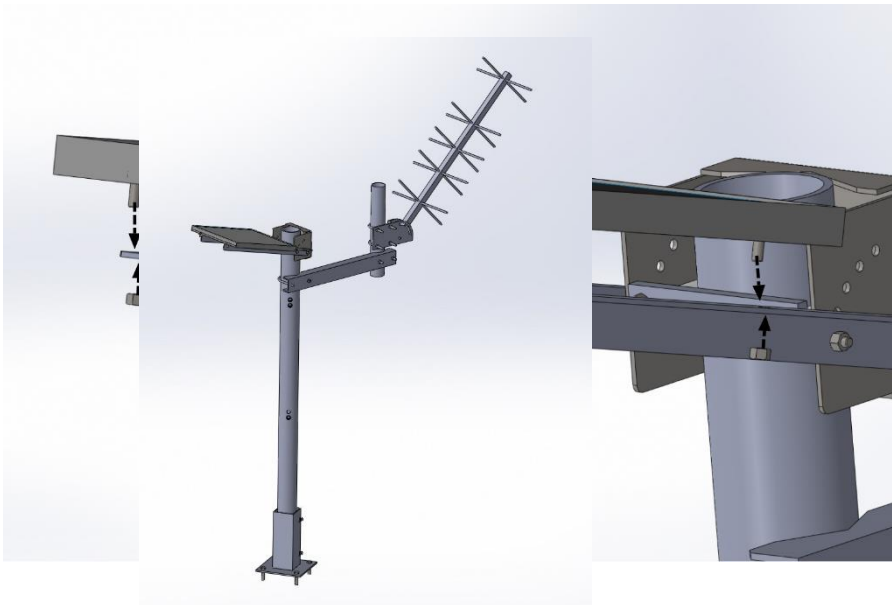


17. Repeat step 22 and 23 with the second panel brace.

18. Insert the screws in the solar panel slides.



19. Insert those screws in the panel braces.
20. Tight the bolts to fix the solar panel properly.
21. YAGI antenna assembled.



22. Connect the transmitter RF Output to the antenna with a RG-8 cable (not provided).

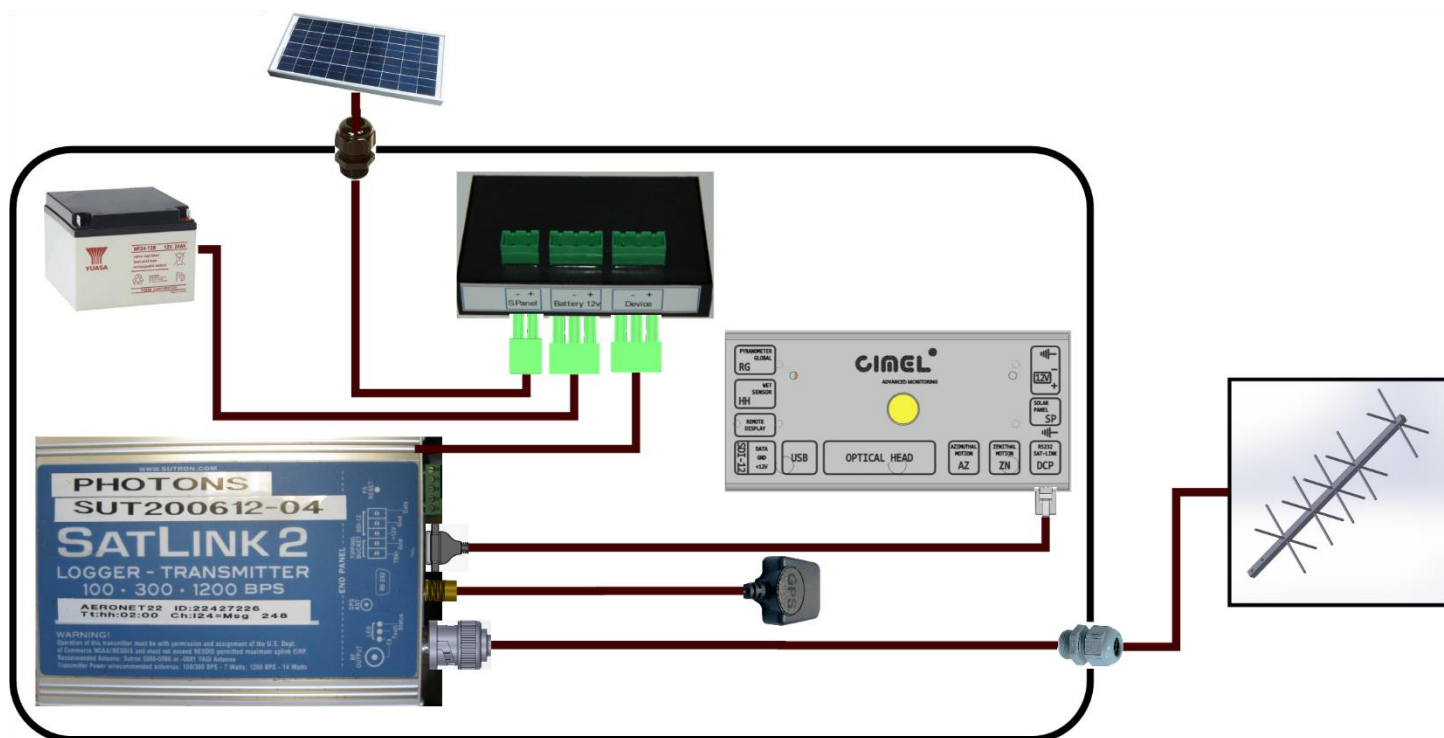
Connect the photometer DCP output to the transmitter RS232 input with the appropriate cable and adaptor.

Power the transmitter using the regulator, the 12 V batteries and the solar panel.

Connect the GPS device to the transmitter GPS antenna input (optional)

Note: It is advisable to buy the cable once the distance there will be between the transmitter and the antenna is approximately known.

Note 2: Check the LED status for a few minutes after having powered the system. If the green led is flashing every 5s, the satellite is correctly set. Otherwise check the Sutron manual to know where the malfunctioning is coming from.



2.3.4.2. Transmitter configuration with the CU

The satellite transmitter configuration is set from the CU menus:

Go in the SETTINGS menu and set the following parameters:

- **DCP.** Set DCP to On to enable satellite communication
- **DCP channel.** Set the channel number. This parameter will be provided by the network administrator on which the instrument is declared (AERONET, PHOTON, CSIRO...)
- **DCP type:** Choose the satellite where the data will be transmitted.
- **DCP ID.** Set the DCP ID. This parameter will be provided by the network administrator.
- **DCP max.** Set the DCP max to 625 for EUMETSAT, 1300 for GOES.
- **DCP interval.** Set the DCP interval to 30 mn for EUMETSAT, 1h for GOES.

- **DCP offset.** It is the time offset from the whole period where the data will be sent. This parameter will be provided by the network administrator.

3 Control Unit navigation menu

3.1. *Capacitive key functions*

The **red** key is used to exit a menu or to cancel an action.

The **green** key is used to enter in a menu or to validate an action.

The **yellow** and **white** keys are used respectively to go up/down in a menu or to increase/decrease an edit value.

The description of the contextual action of each key is displayed at the bottom of the screen.

3.2. *Switch on / Switch off / Standby*

When the CU is powered, display is turned on automatically.

The CU turns into its sleeping mode after one minute of user inactivity. If the scenario menu is open and a scenario is running, the CU doesn't turn off the display until the current scenario is finished.

Press the yellow push button on the removable terminal block to turn on the display when the CU is in sleeping mode.

3.3. *Menu description*

The menu system is a hierarchical menu system.

The main menu is composed of the following parameters:

- SCENARIOS.
- MEASURES.
- MEMORY.
- SETTINGS.
- DATE.
- CIMEL.

3.4. SCENARIOS

The SCENARIO menu varies according to the photometer sensor head option. The table below lists all scenarios available according to the sensor head used. These scenarios are described in part 4.1.

Photometer sensor head option		
Standard	Polarized	BRDF / BRDF 12 filters
OFF	OFF	OFF
PARK	PARK	PARK
GOSUN	GOSUN	GOSUN
TRACKSUN	TRACKSUN	TRACKSUN
ORIGIN	ORIGIN	ORIGIN
SUN	SUN	SUN
SKY	SKY	SKY
BLACK	BLACK	BLACK
HYBRID	HYBRID	ALMUCANTAR
ALMUCANTAR	ALMUCANTAR	PPLAN
PPLAN	PPLAN	CIRCLE
LTRACK SUN	POL. ALMUCANTAR	LTRACK SUN
SKY CALIBRATE	POL. PPLAN	SKY CALIBRATE
BCLSUN	POL. HYBRID	BCLSUN
BCLSKY	LTRACK SUN	BCLSKY
CROSS	SKY CALIBRATE	CURVECROSS
CURVECROSS	BCLSUN	3 SUN
3 SUN	BCLSKY	

GOMOON*	CROSS	
TRACKMOON*	CURVECROSS	
MOON*	3 SUN	
LTRACK MOON*	GOMOON*	
CROSS MOON*	TRACKMOON*	
3 MOON*	MOON*	
	LTRACK MOON*	
	CROSS MOON*	
	3 MOON*	

*: these scenarios are executed only when the moon mode is activated (see part 3.7)

The SCENARIO menu allows the manual launch of an individual scenario. Select and validate a scenario. Choose one of the 3 actions:

Run (yellow button): launch the entire scenario.

Next (green button): change the filter.

Abort (red button): quit the scenario.

Measured values are displayed in real-time on the screen.

Note 1: A scenario cannot be launch in manual mode if an automatically started scenario is running. If the SCENARIO menu is accessed while an automatic scenario is running, the current action of the CU will be displayed (GOSUN, SUN...).

Note 2: If a scenario launched in manual mode is running and the auto mode is active, the next automatic scenario will be inserted in a stack and will be executed after the current manual one.

3.5. MEASURES

Sensors included in the CU measure the additional parameters listed below. Values are displayed in real-time and updated every 5 seconds:

- **Battery:** Voltage of the external battery.
- **Ibattery:** Consumption by the electronic box.
- **Vsolar:** Voltage of the solar panel.
- **Isolar:** Charging current.
- **Vcoin, Vcpu, Vgsm, Vradio:** Internal power supplies.
- **Vrg:** Pyranometer.
- **Wetting:** Measure of the wet sensor. [wet; dry]
- **Temperature:** Temperature inside the electronic box.
- **Humidity:** Humidity inside the electronic box.
- **Pressure:** Current atmospheric pressure.

3.6. MEMORY

The produced data are stored in a non-volatile flash device in the CU.

A backup of the non-volatile flash memory is done in K8 binary format every morning when sun air mass is -8 (sun still set).

The PC displays the internal Photometer SD card as a mass storage disk.

Here is a list and description of the parameters in the MEMORY menu:

- **State:** Display the SD card size and the free space available on it.
- **FORMAT:** Format the SD card. It will be formatted in FAT32 file system.

Procedure to format flash memory is explained in part 5.2.3.

- **SAVE:** Save the flash memory content on the SD card. The generated file is a backup of all of the internal non-volatile flash in binary.
- **EXPORT ASCII:** ASCII files are created from binary data.

3.7. SETTINGS

List and description of the parameters in the SETTINGS menu (default value in bold). These parameters are common to all photometers types except when mentioned.

- **Auto:** Enable or disable automatic measurement. The internal scheduler is executed automatically [OFF; ON]: **OFF**.
- **Moon:** Enable or disable moon measurement. The moon menus are invisible in the SCENARIO menu if this setting is OFF. [OFF; ON]: **OFF**.

- **P. Moon:** Period between two Group L scenarios. [2min; 15min]: **3min**.
- **Country:** Country identification. [0; 255]: **0**.
- **District:** District identification. [0; 255]: **0**.
- **Number:** Number identification. [0; 9999]: **0**.
- **Latitude:** Latitude of the current electronic box. [-90.00°; +90.00°]: **0.0000°**.
- **Longitude:** Longitude of the current electronic box. [-180.00°; +180.00°]: **0.0000°**.
- **Altitude:** Altitude of the current electronic box. [0m; 6000m]: **0m**.
- **Turbo:** Enable or disable the Turbo mode. [OFF; ON]: **OFF**.
- **P. Turbo:** Period between two GROUPS A scenarios. [2min; 6min]: **3min**.
- **Bclsky:** Enable Bclsky mode. [OFF; ON]: **OFF**.
- **P. Bclsun:** Bclsun scenario period. [30s; 360s]: **30min**.
- **AZ offset:** Azimuth robot offset. [-180°; +180°]: **0°**.
- **ZN offset:** Zenith robot offset. [-180°; +180°]: **0°**.
- **DCP:** Enable the DCP communication. [OFF; ON]: **OFF**.
- **DCP Channel:** DCP assigned channel. [0; 266]: **0**.
- **DCP Type:** Type of the used satellite: METEOSAT, GOES 100, GOES 300
 - **DCP ID:** DCP assigned ID. [00000000; FFFFFFFF]: **00000000**.
 - **DCP Max:** Define the maximum number of bytes allowed to be transferred to the DCP. [150; 1292]: **625**.
 - **DCP Interval:** DCP transmission period. [00:00:00; 23:59:59]: **00:30:00**.
 - **DCP Offset:** DCP start period. [00:00:00; 23:59:59]: **00:00:00**.
- **ASea (SEAPRISM):** Azimuthal angle from the sun for the sky & sea measurements. [-180°; +180°]: **-90°**.
- **ZSea (SEAPRISM):** Polar angle for the sky & sea measurements. SKY measurements will be done at the horizontal + Zsea degrees and SEA measurements at horizontal - Zsea degrees. [0°; +180°]: **40°**.
- **NMSea (SEAPRISM):** Number of sea measurements. **11**
- **NMSky (SEAPRISM):** Number of Sky measurements. **3**
- **AHL (SEAPRISM):** Maximum angle on the left side. **-270°**
- **AHR (SEAPRISM):** Maximum angle on the right side. **+270°**

To save new settings, exit from the menu. If a parameter is changed, a dialog message appears and asks to confirm the modifications.

3.8. **DATE**

The CU date and time can be set manually via the “DATE” menu. After the modification, exit from this menu. A dialog message appears and asks to confirm the modification.

3.9. *CIMEL*

Here is a list and description of the parameters in the CIMEL menu:

- **TSV:** displays True Solar Time.
- **ROBOT:** displays the robot azimuthal and polar mechanical switches values
- **GPS INFO:** enter in this menu to enable automatic GPS acquisition. The acquisition starts when the State information is set to "Wait GPS..." If the GPS is active, a (G) suffix is added at the end of the time on the root menu.

The first time, the GPS may take up to 15 min to get the GPS information.

Coordinates are checked daily when sun air mass is -9 . The coordinates are automatically updated if the photometer has been moved over one tenth of a degree in longitude or/and latitude.

- **Password:** not used menu.

4 General description of the scenarios and their sequence

4.1. *Scenario description and sequencing*

Scenarios may be launched either automatically via the scheduler or in manual mode via the SCENARIO menu (see part 3.5).

OFF: launch OFF scenario.

PARK: Launch PARK scenario. The photometer optical head is going to park at the nadir position.

GOSUN / GOMOON: launch GOSUN / GOMOON scenario. The photometer is going to theoretical position of the sun / moon.

TRACK SUN / TRACK MOON: The track scenario consists in tracking the SUN / MOON using the 4 quadrant sensor.

LTRACK SUN / LTRACK MOON: The LTRACK scenario consists in tracking the SUN / MOON permanently. It also measures signal on both channels.

ORIGI: launch ORIGI scenario. The photometer goes to its ORIGIN position which is $+7.5^\circ$ on both azimuthal and polar axes compared to the PARK position.

SUN: The SUN scenario consists in measuring the sun irradiance for all the wavelengths. SUN gains are used and the measurements are done in the following order:

Filters used and their sequence (i for InGaAs channel)		
Standard / Polarized	BRDF	BRDF 12 filters
1020 nm	1020 nm	1020 nm
1640i nm	1640i nm	1640i nm
870 nm	870 nm	870 nm
675 nm	675 nm	675 nm
440 nm	440 nm	440 nm
500 nm	550 nm	500 nm
1020i nm	1020i nm	555 nm
937 nm	937 nm	1020i nm
380 nm	380 nm	937 nm
340 nm	740 nm	782 nm
Head sensor temperature	Head sensor temperature	740 nm
		702 nm
		414 nm
		Head sensor temperature (°C)

MOON (only in Standard and polarized): Same sequence than the SUN measurements. SKY gains are used to measure.

BCLSUN: The BCLSUN scenario consists in launching in continue TRACK/SUN scenario with a time interval defined in SETTINGS menu with **P.bclsun** parameter.

3 SUN / 3 MOON: The 3 SUN / 3 MOON scenario consists in repeating 3 times a SUN / MOON scenario. Temperature is recorded once at the end of the scenario.

SKY: The SKY scenario consists in measuring the sky radiance for several wavelengths. SKY or AUREOLE gains are used and the measures are done in the following order:

Filters used and their sequence (i for InGaAs channel)			
Standard	Polarized	BRDF	BRDF 12 filters
1020 nm AUREOLE	1020 nm AUREOLE	1020 nm AUREOLE	1020 nm AUREOLE
1640i nm AUREOLE	1640i nm AUREOLE	1640i nm AUREOLE	1640i nm AUREOLE
870 nm AUREOLE	870 nm AUREOLE	870 nm AUREOLE	870 nm AUREOLE
675 nm AUREOLE	675 nm AUREOLE	675 nm AUREOLE	675 nm AUREOLE
440 nm AUREOLE	440 nm AUREOLE	440 nm AUREOLE	440 nm AUREOLE

500 nm AUREOLE	500 nm AUREOLE	550 nm AUREOLE	500 nm AUREOLE
380 nm AUREOLE	380 nm AUREOLE	380 nm AUREOLE	555 nm AUREOLE
1020 nm SKY	340 nm AUREOLE	740 nm AUREOLE	782 nm AUREOLE
1640i nm SKY	1020 nm SKY	1020 nm SKY	740 nm AUREOLE
870 nm SKY	1020 nm SKY POL IR 0-1-2-3	1640i nm SKY	702 nm AUREOLE
675 nm SKY	1640i nm SKY	870 nm SKY	414 nm AUREOLE
440 nm SKY	1640i nm SKY POL IR 0-1-2-3	675 nm SKY	1020 nm SKY
500 nm SKY	870 nm SKY	440 nm SKY	1640i nm SKY
380 nm SKY	870 nm SKY POL IR 0-1-2-3	550 nm SKY	870 nm SKY
Head sensor T (°C)	675 nm SKY	1020i nm SKY	675 nm SKY
	675 nm SKY POL VIS 0-1-2-3	380 nm SKY	440 nm SKY
	440 nm SKY	740 nm SKY	500 nm SKY
	440 nm SKY POL VIS 0-1-2-3	Head sensor T (°C)	555 nm SKY
	500 nm SKY		1020i nm SKY
	500 nm SKY POL VIS 0-1-2-3		782 nm SKY
	380 nm SKY		740 nm SKY
	380 nm SKY POL UV 0-1-2-3		702 nm SKY
	340 nm SKY		414 nm SKY
	340 nm SKY POL UV 0-1-2-3		Head sensor T (°C)
	Head sensor T (°C)		

BCLSKY: The BCLSKY scenario consists in performing 10 SKY scenarios at the zenith if the sun is hidden.

BLACK: The black scenario consists in measuring the electronic noise of the device. The filter-wheel is positioned in between two filters so that the signal coming through the two channels is cut.

Important note: The signal measured is the dark current. It is subtracted to the full signal measured. It is also an indicator for a possible electronic failure if too big.

Measures are done in the following order:

- AUREOLE gain, silicon channel (canal 1)
- AUREOLE gain, InGaAs channel (canal 2)
- SKY gain, silicon channel

- SKY gain, InGaAs channel

SKY CALIBRATE: The SKY CALIBRATE scenario consists in performing 3 SKY and 1 BLACK scenario.

HYBRID (Standard, Polarised): Scenario validation in progress. Description is not available yet.

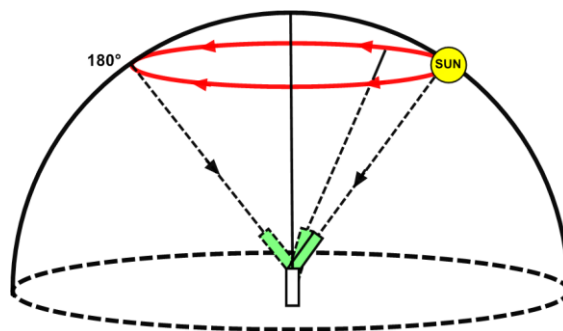
ALMU (Standard, BRDF) / ALMUP (Polarised): The **ALMU**cantar technique consists in measuring the sky radiance in aerosol channels, keeping a constant polar angle equal to the zenith solar angle with varying azimuthal angle.

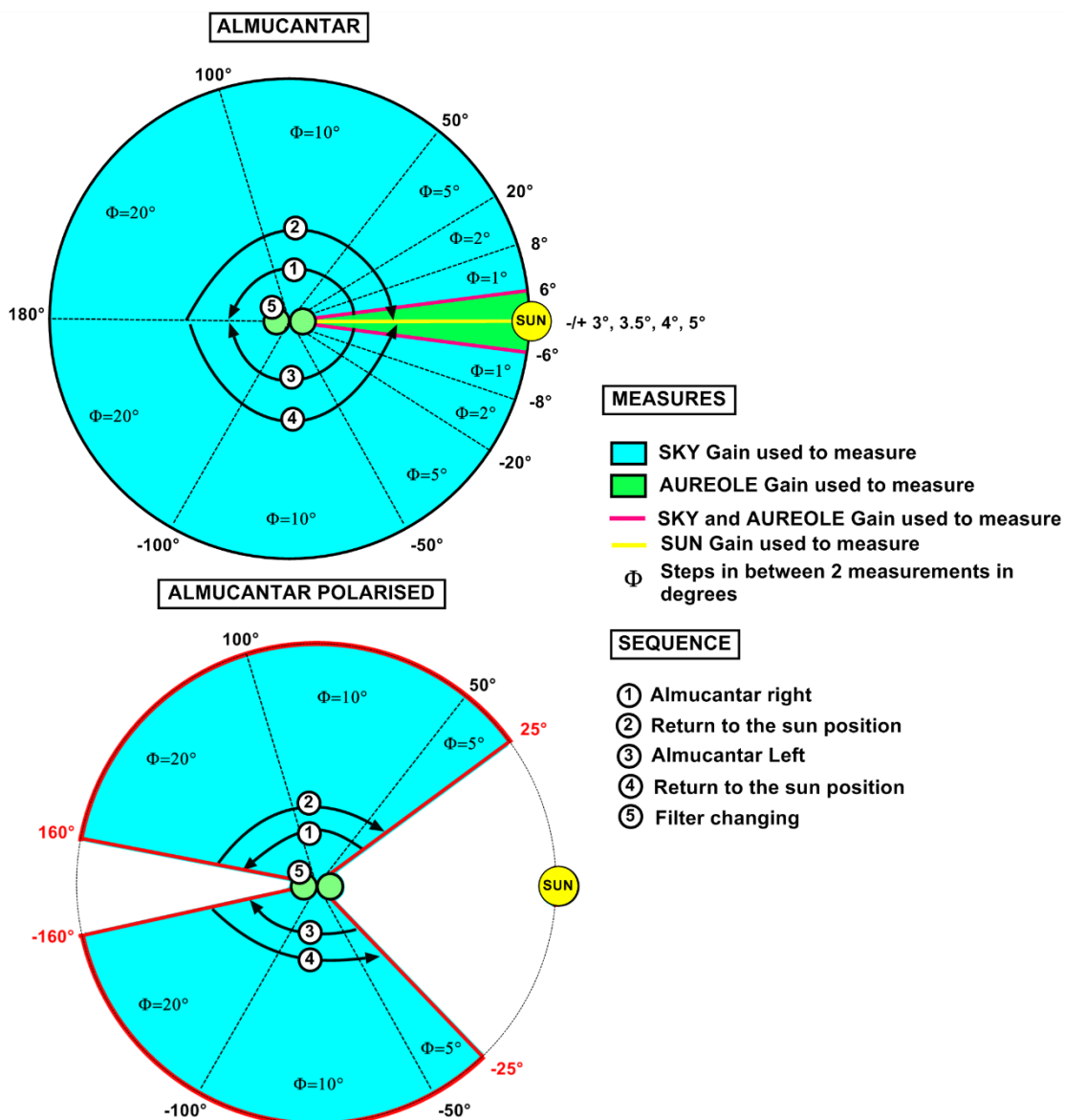
In the ALMU scenario, azimuthal angles vary from 0° to $+180^\circ$ for an almucantar right and 0° to -180° for an almucantar left using:

- SUN gain on the sun
- AUREOLE gain between -6° and $+6^\circ$
- AUREOLE and SKY gain for 6° and SKY gain between 6° and 150°

In the **ALMU**cantar **Polarised** scenario, azimuthal angles vary from 25° to $+160^\circ$ for an almucantar right and -25° to -160° for an almucantar left using SKY gain only.

Below is a visual description of the Almucantar and Polarised Almucantar.





Standard	Polarized	BRDF	BRDF 12 filters
1020 nm	1020 nm SKY POL IR 0-1-2-3	1020 nm	1020 nm
1640i nm	1640i nm SKY POL IR 0-1-2-3	1640i nm	1640i nm
870 nm	870 nm SKY POL IR 0-1-2-3	870 nm	870 nm
675 nm	675 nm SKY POL VIS 0-1-2-3	675 nm	675 nm
440 nm	440 nm SKY POL VIS 0-1-2-3	550 nm	500 nm
500 nm	500 nm SKY POL VIS 0-1-2-3	380 nm	550 nm
380 nm	380 nm SKY POL UV 0-1-2-3	740 nm	1020i nm
Sensor head T (°C)	340 nm SKY POL UV 0-1-2-3	1020i nm	782 nm

	Head sensor T (°C)	Sensor head T (°C)	740 nm
			702 nm
			714 nm
			Sensor head T (°C)

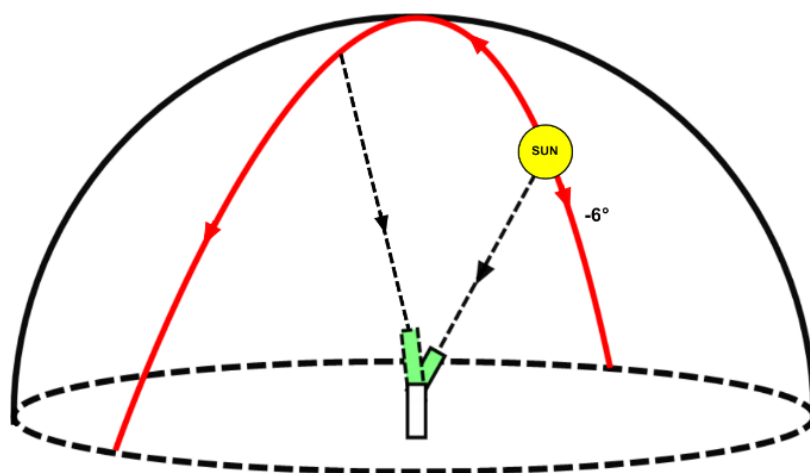
PP / PPP: The **P**rincipal **P**lan technique also consists in measuring the sky radiance in the aerosol channels. Unlike the almucantar, a constant azimuthal angle is kept with varying polar angle to make measurements.

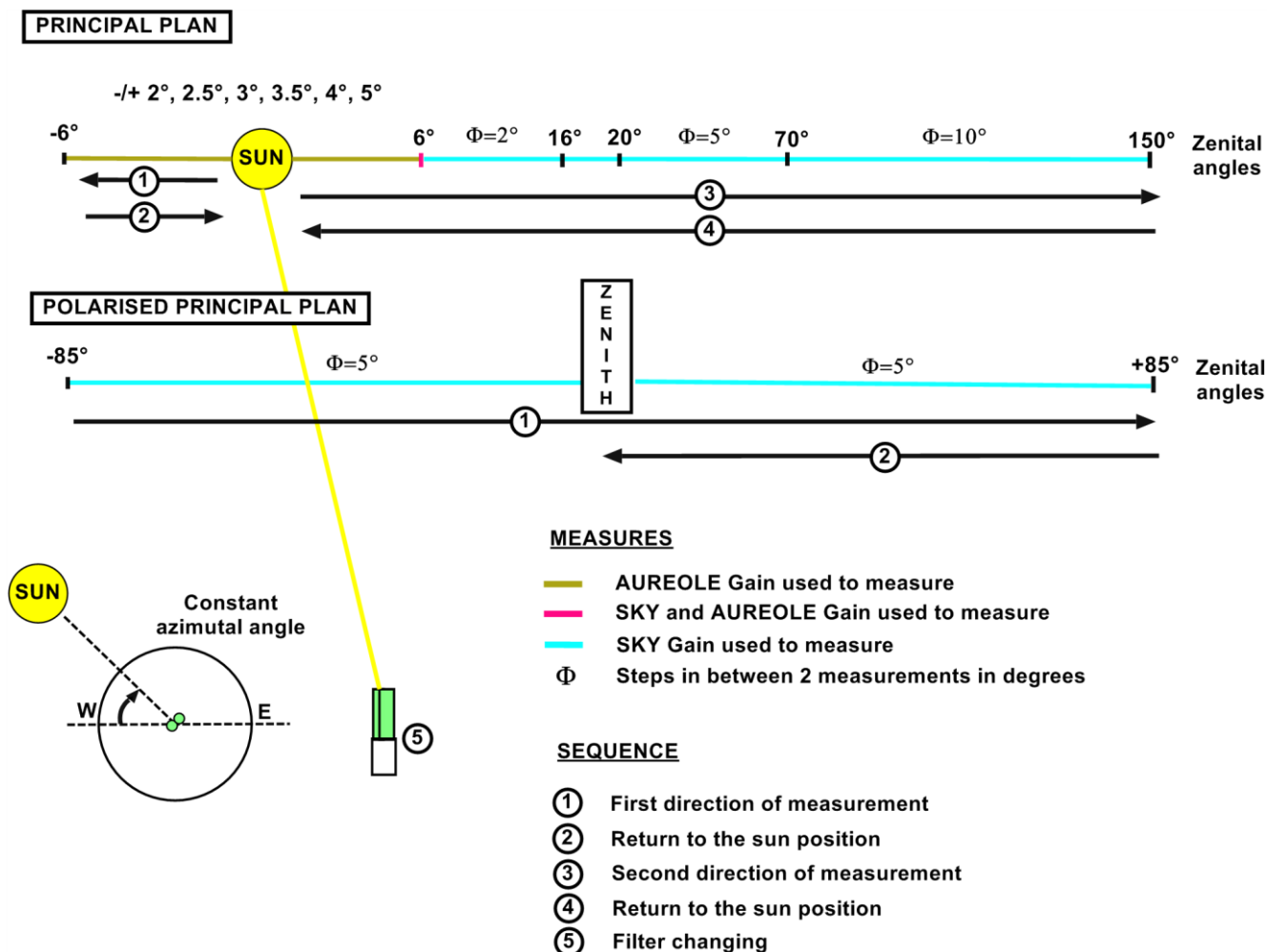
In the PP scenario, polar angles vary from -6° to $+150^\circ$ using:

- SUN gain on the sun
- AUREOLE gain between -6° and $+6^\circ$
- AUREOLE and SKY gain for 6° and SKY gain between 6° and 150°

In the **P**rincipal **P**lane **P**olarized scenario, polar angles vary from -85° to $+175^\circ$ using SKY gain only.

Below is a visual description of the Principal Plan and Polarised Principal Plan.





Filters used and their order in the sequence			
Standard	Polarized	BRDF	BRDF 12 filters
1020 nm	1020 nm SKY POL IR 0-1-2-3	1020 nm	1020 nm
1640i nm	1640i nm SKY POL IR 0-1-2-3	1640i nm	1640i nm
870 nm	870 nm SKY POL IR 0-1-2-3	870 nm	870 nm
675 nm	675 nm SKY POL VIS 0-1-2-3	675 nm	675 nm
440 nm	440 nm SKY POL VIS 0-1-2-3	550 nm	500 nm
500 nm	500 nm SKY POL VIS 0-1-2-3	380 nm	550 nm
380 nm	380 nm SKY POL UV 0-1-2-3	740 nm	1020i nm
Sensor head T (°C)	340 nm SKY POL UV 0-1-2-3	1020i nm	782 nm
	Head sensor T (°C)	Sensor head T (°C)	740 nm

			702 nm
			714 nm
			Sensor head T (°C)

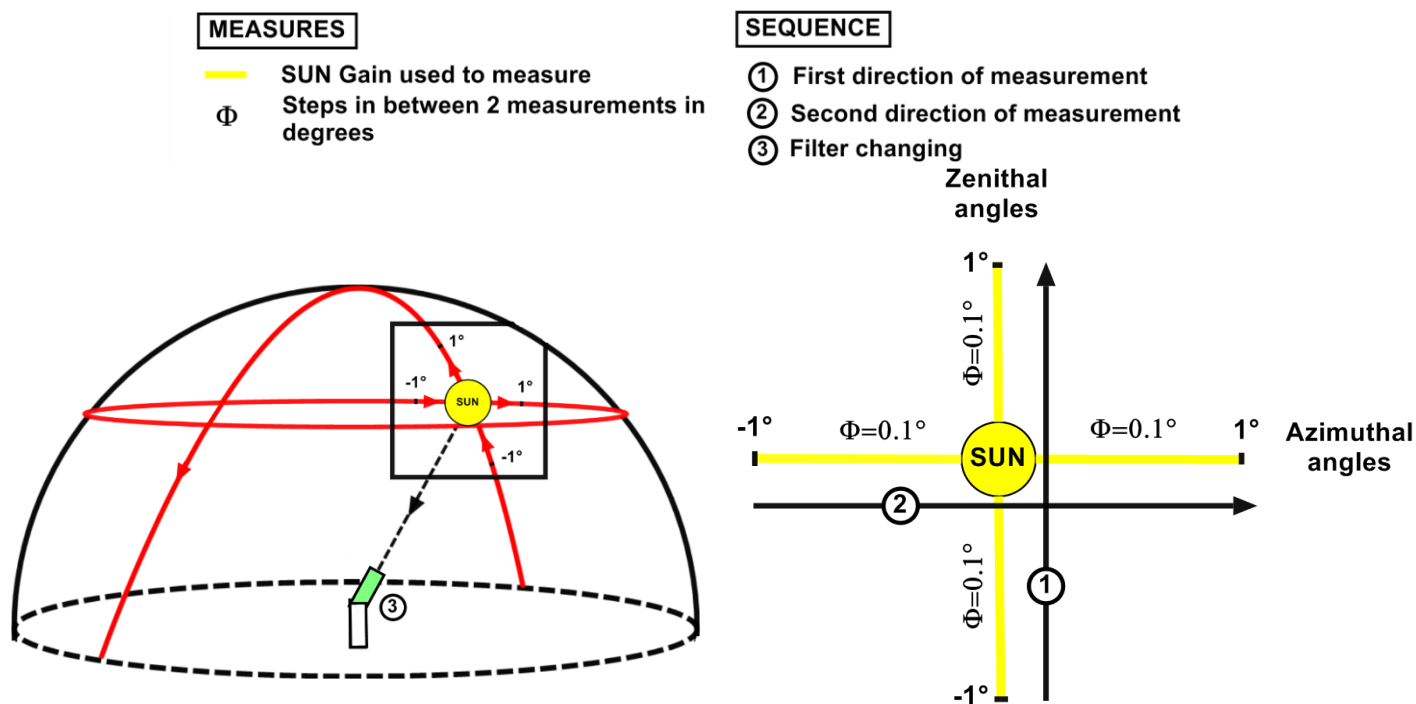
CROSS SUN / MOON: The Cross Sun / Moon scenario consists in measuring sun or moon irradiance in 2 bands for several angles close to the sun / moon, using a cross scheme.

In Cross Sun / Moon scenario:

- Polar angles vary from -1° to 1° (by 0.1° increments) using SUN / SKY gain with constant azimuthal angle
- Azimuthal angles vary from -1° to 1° (by 0.1° increments) using SUN / SKY gain with constant polar angle.

For each pointing position, the scenario also acquires service data from the 4 quadrant detector: X difference, Y difference and Total. This information may be used to check the correct alignments of the 4-quadrant optical axis with each measurement optical axis.

Below is a visual description of the Cross Sun / Moon.



Revision 4.3 January 2018

Filters used and their sequence			
Standard	Polarized	BRDF	BRDF 12 filters
1020 nm	1020 nm	1020 nm	1020 nm
1640i nm	1640i nm	1640i nm	1640i nm

CURVATURE CROSS: Scenario validation in progress. Description not available yet.

CIRCLE (only with BRDF photometers): The CIRCLE scenario consists in measuring at the constant polar with varying azimuthal angles from 0 to 360° with 5° steps using SKY gains.

Filters used and their sequence	
BRDF	BRDF 12 filters
1640 nm (InGaAs channel)	1640 nm (InGaAs channel)
870 nm	870 nm
675 nm	675 nm
440 nm	440 nm
550 nm	500 nm
740 nm	550 nm
	782 nm
	740 nm
	702 nm
	414 nm

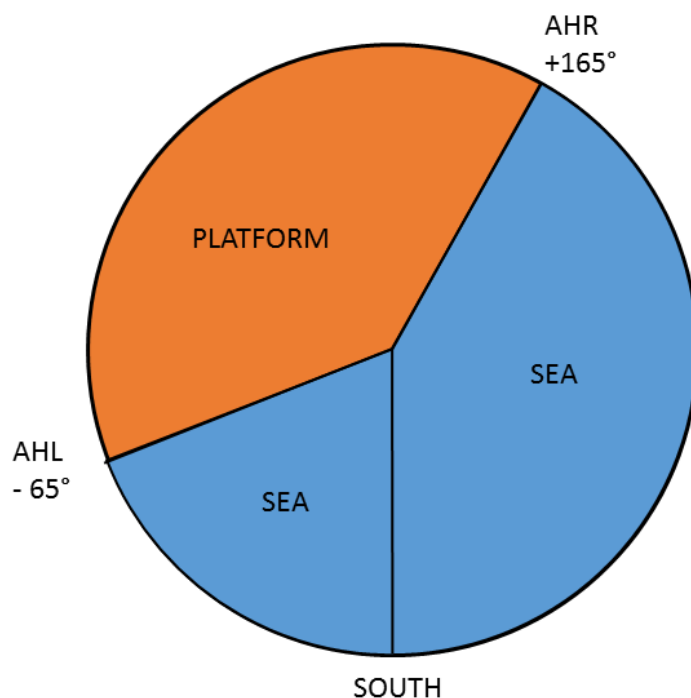
BRDF (only with BRDF photometers): The BRDF scenario consists in launching successive CIRCLE scenarios, starting from a polar angle of 5° and finishing with a polar angle of 60°.

Filters used and the sequence is the same than CIRCLE scenario

SPR (only with SEAPRISM photometers): The SeaPRism scenario consists in making M measures on the sea and N on the sky (see NMSea, NMSky parameters). This scenario is executed 8 times one for each filter.

It is important to notice that AHL and AHR parameters impose spatial restrictions in Sea measurements. Indeed ideally the photometer would have a field of view of 360° to make sea measurements. In practice, the photometer is usually installed on an off-

shore platform or on a jetty. Then the field of view is reduced and AHL and AHR enable to set this reduced field of view to only measures the sea radiance.



Filters used and their sequence
SEAPRISM
1020 nm
870 nm
670 nm
440 nm
531 nm
740 nm
412 nm
500 nm
550 nm

SUNP (Polarised): The **SUN** Polarised scenario consists in measuring the Sun directly on all polarisers with all filters.

Filters used and their sequence
Polarized
1020 nm SUN POL IR 0-1-2-3
1640i nm SUN POL IR 0-1-2-3
870 nm SUN POL IR 0-1-2-3
675 nm SUN POL VIS 0-1-2-3
440 nm SUN POL VIS 0-1-2-3
500 nm SUN POL VIS 0-1-2-3
937 nm SUN POL IR 0-1-2-3
380 nm SUN POL UV 0-1-2-3
340 nm SUN POL UV 0-1-2-3

Note 1: This scenario is only used to check the polarisers.

MOONP (Polarised): The **MOON** Polarised scenario consists in measuring the Moon directly on all polarisers with all filters except 937, 380 and 340nm.

Filters used and their sequence
Polarized
1020 nm SKY POL IR 0-1-2-3
1640i nm SKY POL IR 0-1-2-3
870 nm SKY POL IR 0-1-2-3
675 nm SKY POL VIS 0-1-2-3
440 nm SKY POL VIS 0-1-2-3
500 nm SKY POL VIS 0-1-2-3

4.2. *Group of measurement scenarios*

In auto mode, the photometer follows a schedule and automatically launches both individual scenarios and group of measurement scenarios.

The following groups of scenarios are used:

Group name	Measures
Group A	3 SUN;
Group B	3 SUN; HYB; 3 SUN; HYBP ; 3 SUN; ALMU; 3 SUN; ALMUP
Group C	3 SUN; HYB; 3 SUN; HYBP ; 3 SUN; ALMU; 3 SUN; ALMUP ; 3 SUN; PP; 3 SUN; PPP
Group D	3 SUN; CRO; BLACK
Group E	3 SUN; ALMU; 3 SUN; ALMUP
Group F	3 SUN; SUNP; HYB; 3 SUN; HYBP; 3 SUN; ALMU; 3 SUN; ALMUP; 3 SUN; PP; 3 SUN;
Group L	3 MOON; MOONP
Group P	3 SUN; SPR

Group S	3 SUN; ALMU; PP; BRDF; BLACK;
---------	-------------------------------

Note 1: **In bold**, measures that are done only with the polarised photometers. By default only HYBP is done. ALMUP and PPP have to be activated in PW on the CU.

Note 2: the group S is only done by the BRDF photometers.

Note 3: the group P is only done by SEAPRISM photometers.

Note 4: SUNP and MOONP have to be activated in PW on the CU.

4.3. *Day and night measurement schedule in Auto mode*

4.3.1. Standard and polarized

The photometer follows a daily schedule of automatic actions. Some actions are triggered by the time of the day and some by the air mass which is related to the thickness of atmosphere the sun light has been through to get to the photometer (Langley times). The Langley times depend on both the site where the photometer is located and the date. They are automatically calculated and set in the photometer sequence list each day at 1AM.

Moreover night time measurements can be done. It is important to notice that **night time measurements are not activated by default**.

To activate night time measurements and to choose the measurement period, go in the SETTINGS menu on the CU. (See part 3.7)

- switch ***Moon*** setting to **ON**
- choose a value between 2 and 15 mn in ***P.moon*** setting (default 3mn)

Automatic actions done by the photometer in Auto mode (day and night time):

Air mass	Equivalent zenith angle	Group
Air mass 7.0	81.8°	Group A
Air mass 6.5	81.15°	Group A
Air mass 6.0	80.40°	Group A
Air mass 5.5	79.52°	Group A
Air mass 5.0	78.46°	Group A

Air mass 4.5	77.16°	Group A
Air mass 4.0	75.52°	Group E
Air mass 3.8	74.74°	Group A
Air mass 3.6	73.87°	Group A
Air mass 3.4	72.89°	Group A
Air mass 3.2	71.79°	Group A
Air mass 3.0	70.53°	Group C
Air mass 2.8	69.07°	Group A
Air mass 2.6	67.38°	Group A
Air mass 2.4	65.37°	Group A
Air mass 2.2	62.96°	Group A
Air mass 2.0	60°	Group B
Air mass 1.7	53.97°	Group B

Morning times	Afternoon times	Group
09H00	15H00	Group C
09H15	14H45	Group D
09H30	14H30	Group A
09H45	14H15	Group A
10H00	14H00	Group C
10H15	13H45	Group A
10H30	13H30	Group A
10H45	13H15	Group A
11H00	13H00	Group C / Group F
11H15	12H45	Group A
11H30	12H30	Group A
11H45	12H15	Group A
12H00		Group C / Group F

Note: If air masses measurements times come after 9H00 or before 15H00, they are skipped. The defined times scheduler gets the priority.

An empty period without any measurements may exist between air mass 1.7 and 9H00 in the morning and between 15H00 and air mass 1.7 in the afternoon. If it is the case, the following scheduler is executed:

Morning times	Afternoon times	Group
07H30	15H15	Group A
07H45	15H30	Group A
08H00	15H45	Group C
08H15	16H00	Group A
08H30	16H15	Group A
08H45	16H30	Group A

Night time measurements are executed if:

- The moon phase is between the first and last quarter
- Moon air mass is higher than 7
- Sun air mass is below -7. Sun air mass below -7 means that the sun is already set and far enough so that it is not lightening too much the sky.

Measurement period	Group
Between 2 and 15 mn; default value 3 mn	Group L

4.3.2. BRDF and BRDF 12 filters

The BRDF Photometer executes **Group S** scenario every day from sun air mass 5 in the morning to sun air mass 5 in the evening. (A group S scenario is around 2h long).

The group S scenario automatically starts at a round True Solar Time minute if no other scenario is running.

Note 1: The Almucantar is executed only if the sun zenith is between air mass 4.0 and air mass 1.5.

Note 2: A PARK, GOSUN and 3SUN are executed between each zenith angle change.

4.3.3. SEAPRISM

The SEAPRISM photometer executes **group P** scenario every day from sun air mass 5 in the morning to sun air mass 5 in the evening. The group P scenario automatically starts at every round hour and half hour True Solar Time.

Before air mass 5 and after air mass 5 the SEAPRISM photometer executes the STANDARD scheduler.

4.3.1. Polarised

After each 3 MOON scenario, the Polarised photometer can execute a MOONP scenario.

Note 1: The “Pol moon” setting has to be activated in PW of the CU.

5 On-site maintenance

5.1. *Weekly check preventive maintenance*

Before making any preventive maintenance, switch the CU in manual mode (see part 3.7).

Here is a procedure that should be done every week in order to prevent the occurrence of measurement, electronic or mechanical problems on the photometer. If correctly done this procedure will avoid most of the problems that may occur:

1. Check all the connections, especially the ones on the battery (rust). Check the sensor head cable. Check that the AZ and ZN cables are not wrapped around the robot.
2. Check that the communication between the acquisition PC and the photometer is still OK. If used, check that the satellite transmitter is still running and does not have any errors by checking the led status.

If a problem is encountered, please refer to the troubleshooting part.

3. Check that the wet sensor functions correctly. Clean it lightly with demineralised water and a non-abrasive tissue.

→ Go in the MEASURES menu and look at wetting parameter. (See part 3.4)

If wet, “wet” is displayed, if not “dry” is displayed. In order to test the sensor if it is not raining, wet it with water and wait around 20s, the value of wetting should go from “dry” to “wet”.

If a problem is encountered, please refer to the troubleshooting part.

4. Check that the robot is correctly levelled

→ Check that the level spirit of the robot is well centred.

If not, please check step 18 of the installation part to solve the problem.

5. Check the voltage of external batteries and the DCP battery if used

→ Check the photometer external battery measuring the voltage of the battery terminals. The voltage should be over 12 Volts.

→ Same process for the DCP battery if used

Check the batteries general state. There must be no rust, leak and so on.

6. Disassemble the collimator from the sensor head. Check each channel inside the collimator for possible obstruction. If necessary, clean it with dry air or very carefully with a bottlebrush. It should be perfectly clean.

7. Check the four quadrant sensor. If dirty clean it with a cotton swab.

Warning: Never clean the 2 main lenses on the front plate, except after a dust event when they can be cleaned with dry air.

The effect of the increasing dirt on the lenses due to time deposition can be corrected at the data processing stage. Cleaning them will distort the calculations.

8. Checking if the GOSUN and the TRACK are correct.

→ Launch a GOSUN scenario and look at the position of the sun spot compared to the target on the collimator base.

If a large shift is visible on the azimuthal axis, please watch step 14 in the installation part.

→ Launch a TRACK scenario and look if the sun spot is perfectly centred on the target on the collimator.

If a problem is encountered, please refer to the troubleshooting part.

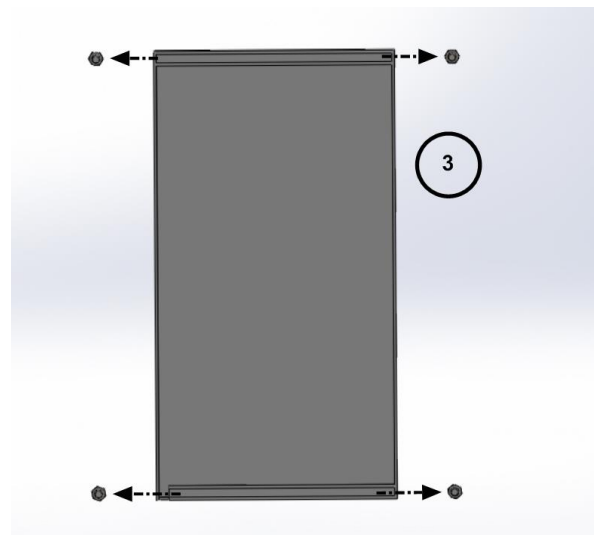
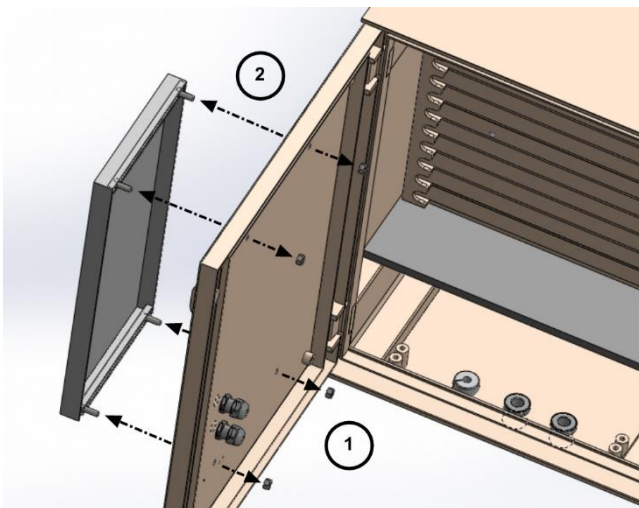
5.2. *Corrective maintenance*

5.2.1. Solar panel and wet sensor replacement

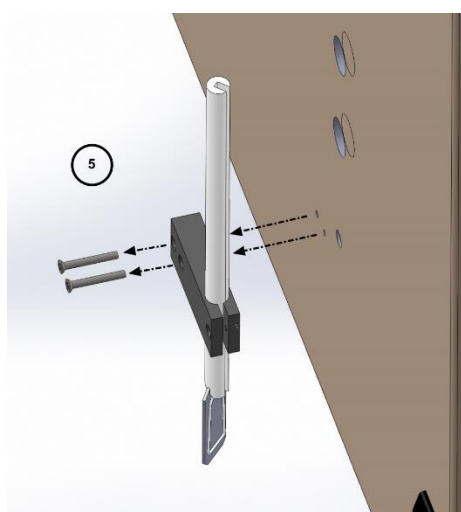
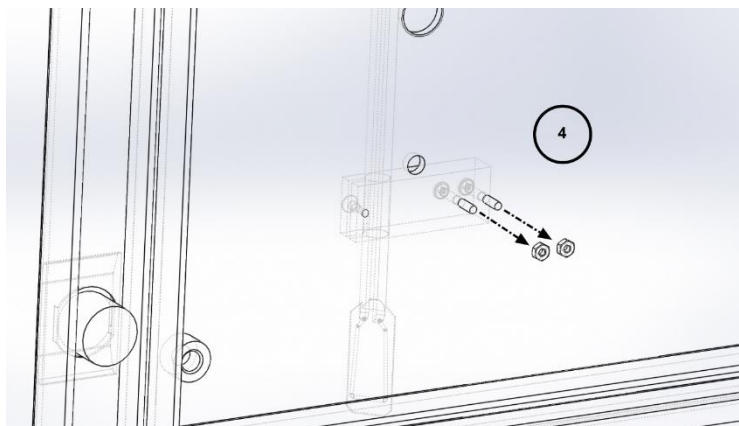
The wet sensor and the solar panel on the case are already mounted. They might be replaced in case of breakdown.

1. Loosen the 4 nuts.
2. Withdraw the solar panel with its wire cautiously from the protection case.
3. Get back the 4 screw which are inserted in the solar panel slides and replace the solar panel.

Note: To replace the wet sensor, the solar panel needs to be uninstalled.



4. Loosen the 2 nuts maintaining the probe clamp
5. Withdraw the screw and the wet sensor with its wire from the protection case
6. Slide the wet sensor to get it back and replace it.



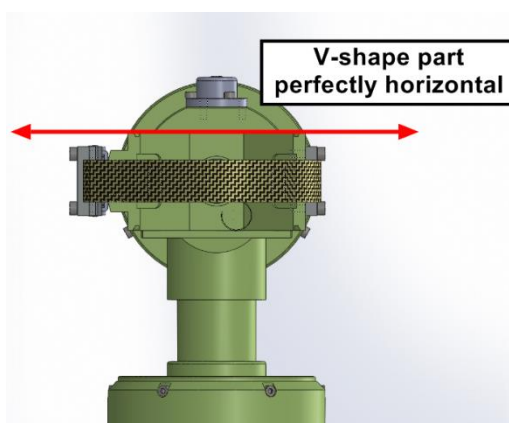
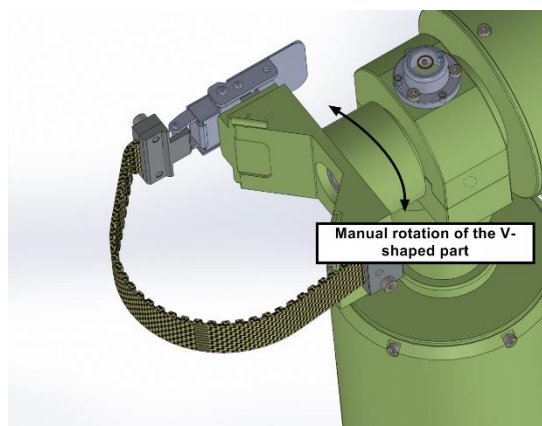
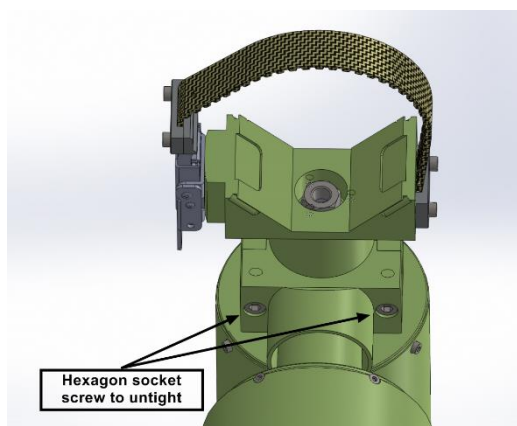
5.2.2. Robot levelling adjustment

After a PARK scenario, even if the spirit level is well-centred, it might happen that the V-shape part of the robot is not perfectly horizontal. You can check with a leveller.

If the case happens:

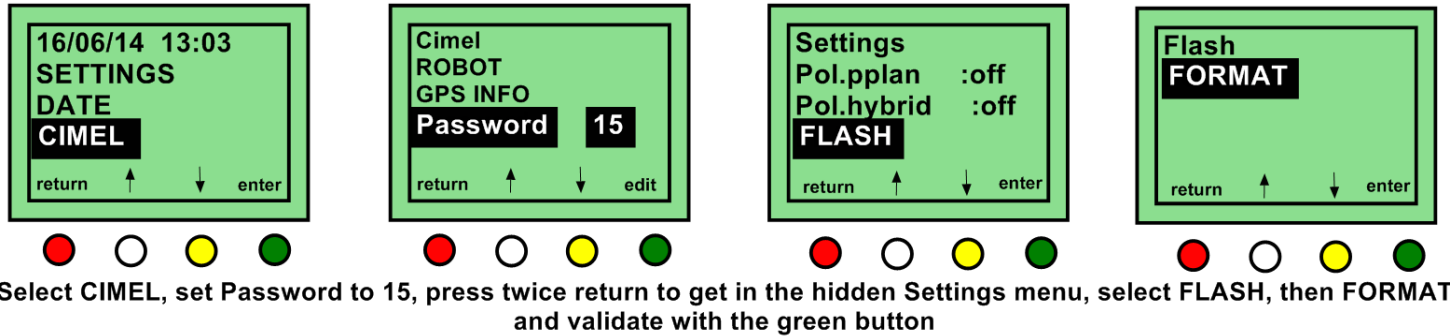
1. Loosen the 2 hexagon socket screws.

2. Rotate the robot horizontal axis so that the V-shaped part is perfectly horizontal. Check with the leveller.
3. Tighten the screws and check is the V-shape part is perfectly horizontal after having launched a PARK scenario.



5.2.3. Flash memory formatting

Flash memory can be formatted via a hidden menu by following this procedure:



6 Factory calibration and maintenance

6.1. *Sensor head calibration and maintenance*

Cimel recommends its customers to calibrate the photometers every 12 to 24 months.

The calibration consists in a SKY calibration using an integrating sphere and a SUN calibration by inter-comparison or using Langley plots method.

The calibration process also includes:

- verification of filters and replacement if necessary
- verification of detectors and replacement if necessary
- Verification of acquisition chain
- verification of sun tracking setting and replacement if necessary

6.2. *Robot maintenance*

Cimel recommends its customers to make maintenance on the robot every 36 to 48 months.

It consists in:

- Replacement of micro switches

- Replacement of transmission belts
- Full cleaning of transmission gears, greasing of transmission gears and aging.

7 Troubleshooting

7.1. *Communication and data transfer is down*

7.1.1. Using serial port transfer protocol

The possible causes that may interrupt the communication between the PC and the photometer are:

- A power cut happened and the PC restart has not been executed properly.
- The serial wire is not correctly plugged or KO.
- The serial port is down.
- PhotoGetData is not well configured.
- DCP parameter is set to ON (conflict created).

Procedure to follow:

- Check that the computer is switched on.
- Check that PhotoGetData is launched.
- Check in the configuration menu that the right port COM is selected.
- Check that the serial cable is well plugged on both computer and photometer side.
- Test manually the data transfer by clicking on **get records** in PhotoGetData.
- Make sure that the DCP parameter is set to OFF.

If the manual test is working:

- Check that the automatic data transfer is well configured.

If the communication is still not working:

- Try another cable.
- Try another port COM on the acquisition computer if possible

If this procedure does not solve the problem, please contact CIMEL technical support.

7.1.2. Using satellite transmitter

The possible causes that may interrupt the communication between the photometer and the satellite are:

- The battery voltage is too low to transfer the data to the satellite.
- The satellite transmitter is no more finding the satellite.
- The emitter antenna is not correctly set.
- GPS antenna is missing, not correctly positioned or damaged.

Procedure to follow:

- Check that the DCP voltage battery is over 12V.
- Check that the cable is OK and correctly plugged between the transmitter and the photometer.
- Check the transmitter functioning status LED and up to the status, follow the transmitter documentation.
- Check that the GPS plugged on the transmitter have a good view of the sky.

If this procedure does not solve the problem, please contact CIMEL technical support.

7.2. *Bad sun tracking*

If the photometer is declared in AERONET “bad sun tracking” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The possible causes that may lead to a bad sun tracking are:

- The sun spot is too far from the target after a GOSUN scenario (see step 11 and 16 in the installation part).
- The external battery is too low.
- The sensor head cord is damaged.
- The four quadrants sensor is too dirty.
- The four quadrants sensor is broken.
- The collimator is not correctly assembled to the sensor head.
- The collimator is deformed.
- The robot base is not horizontal.

Procedure to follow:

- Make sure that the sun spot after a GOSUN scenario is not too far away from the target on the collimator.
- Check the battery voltage, it must be over 12V.
- Clean the four quadrant sensor with a cotton swab.
- Check visually the external state of the sensor.
- Check if the collimator is correctly assembled.
- Check the spirit level.

If this procedure does not solve the problem, it means that the sensor head cord is probably damaged.

Please contact Cimel technical support for any damaged sensor head cord or if the procedure is not solving the problem.

7.3. *InGaAs / silicon discrepancy*

If the photometer is declared in AERONET network, “InGaAs / Silicon discrepancy” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

If not declared, it is difficult to detect this discrepancy easily. A measure with the 1020 nm is done either on the silicon and the InGaAs channel. Algorithms are checking the ratio in between the two measures and it should be constant.

The main cause that may lead to these discrepancies is:

- One of the channel or both channels are obstructed by something (spider web, insects...).

Procedure to follow:

- Clean the collimator with dry air or a bottlebrush and make sure that nothing is obstructing the channels.

If this procedure does not solve the problem, please contact CIMEL technical support.

7.4. *High dark current*

If the photometer is declared in AERONET network, “high dark current” warning flags may be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The dark current is regularly measured when a BLACK scenario is done on both InGaAs and silicon channel with AUREOLE and SKY gain.

The dark current should always be low, and under a certain threshold.

The main cause that may lead to a high dark current:

- An electronic component is damaged, defective or not correctly plugged.

Procedure to follow:

- Make sure that all the connectors on the card inside the CU are correctly plugged.

- Check all external cables and wires especially the connections.

If this procedure does not solve the problem, please contact CIMEL technical support.

7.5. Constant humidity

If the photometer is declared in AERONET network, “constant humidity” warning flags can be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The possible causes that may lead to a constant humidity:

- Continuous rain (4 days a week with rain the full day).
- The wet sensor is close to the sea or the ocean and the wind carries on regularly marine spray on its direction.
- Dew in the morning takes a long time to evaporate.
- The wet sensor is damage, time worn or broken. The wet sensor is quite sensitive, especially the resistive part on its head which can be deteriorated with rough meteorological conditions.

Procedure to follow:

- Try to slightly orientate the sensor to the West, it will then be exposed quicker to the morning sun and the dew will evaporate faster.
- Try to protect the wet sensor from possible marine spray.

7.6. Robot errors

The possible causes that may lead to robot errors:

- The cables are wrapped around the robots.
- The battery is low.
- The switches are damaged.

Procedure to follow:

- Check if the cables are wrapped around the robots.

- Unplug and plug again the azimuth (AZ) and zenith (ZN) cables.
- Launch a PARK scenario.

If the PARK is not well executed after having done the procedure, the mechanical switches might be damaged or broken. To check that, follow the procedure:

- Go to ROBOT in the CIMEL menu.
- Look at the sae (switch angle engagement) values for AZ and ZN.
- These values should be between 70 and 90.

If it is not the case please contact CIMEL technical support.

7.7. Dissymmetric Almucantar

If the photometer is declare on the AERONET network, dissymmetric almucantar warning flags can be emitted. They will be emitted on this website:

http://aeronet.gsfc.nasa.gov/cgi-bin/weekly_report_v2

The main cause of dissymmetric Almucantar is an incorrectly levelled robot.

Procedure to follow:

- Redo step 18 in the installation chapter.

7.8. Battery low

The possible causes that may lead to a low battery:

- The solar panel is down and the battery is not reloaded.
- A long period without any sun.
- The connections are not plugged correctly.
- Connections are rusted (marine spray).
- The battery is too old or broken.

Procedure to follow:

- Check if the cables are correctly plugged and the cables are not damaged.

- Check if the battery has no leakage and is powerful enough.

If this has not solved the problem, please contact Cimel technical support.

8 Frequently Asked Questions (FAQ)

1. How often should the calibration process be made?

The photometer should go through the calibration process every 12 to 24 months. Depending on the quality of the measurements, the season, and the meteorological phenomenon that occurs, the calibration process can be forwarded or postponed up to 3 months.

2. What does the calibration process consisting in?

The calibration consists in a sky calibration by inter-comparison with an integrating sphere and a sun calibration by inter-comparison with master photometers.

3. What is the best place to put the photometer?

The photometer should be positioned in a place sheltered from the wind if possible and with an open sky, meaning that it will be able to track the sun without any obstacle from sunrise to sunset.

If possible, a RS232 link will be installed for transfer data to a PC. The cable length should not exceed 100m.

4. Can I replace components myself?

Components can be replaced by the owner after diagnosis has been established by CIMEL technical support. Never try to replace a component by yourself without CIMEL approval.

However, the sensor head should never be disassembled as it will unset the sky and sun calibrations.

5. What is the AERONET network?

The AERONET (AErosol ROBotic NETwork) program is a ground-based remote sensing federation of networks established by NASA and PHOTONS. Data acquired by all the photometers are gathered by the central system and a large number of quality insured products are made available for public access.

6. How to enter it?

To enter the network, a request must be sent to AERONET. See AERONET website.

7. What are the first things to do when I notice that the photometer is down?

The first things to do when the photometer is down is to put back the photometer in manual mode and launch a PARK scenario, until the first investigations and diagnosis can be done.

8. What are the main outputs of the photometer?

The main output of the photometer is the calculation of the optical depth (AOD) which is an important atmospheric parameter as it is linked to the aerosol concentrations in the sky. Others output values are calculated if in the AERONET network.

9. What happens when the wet sensor is activated?

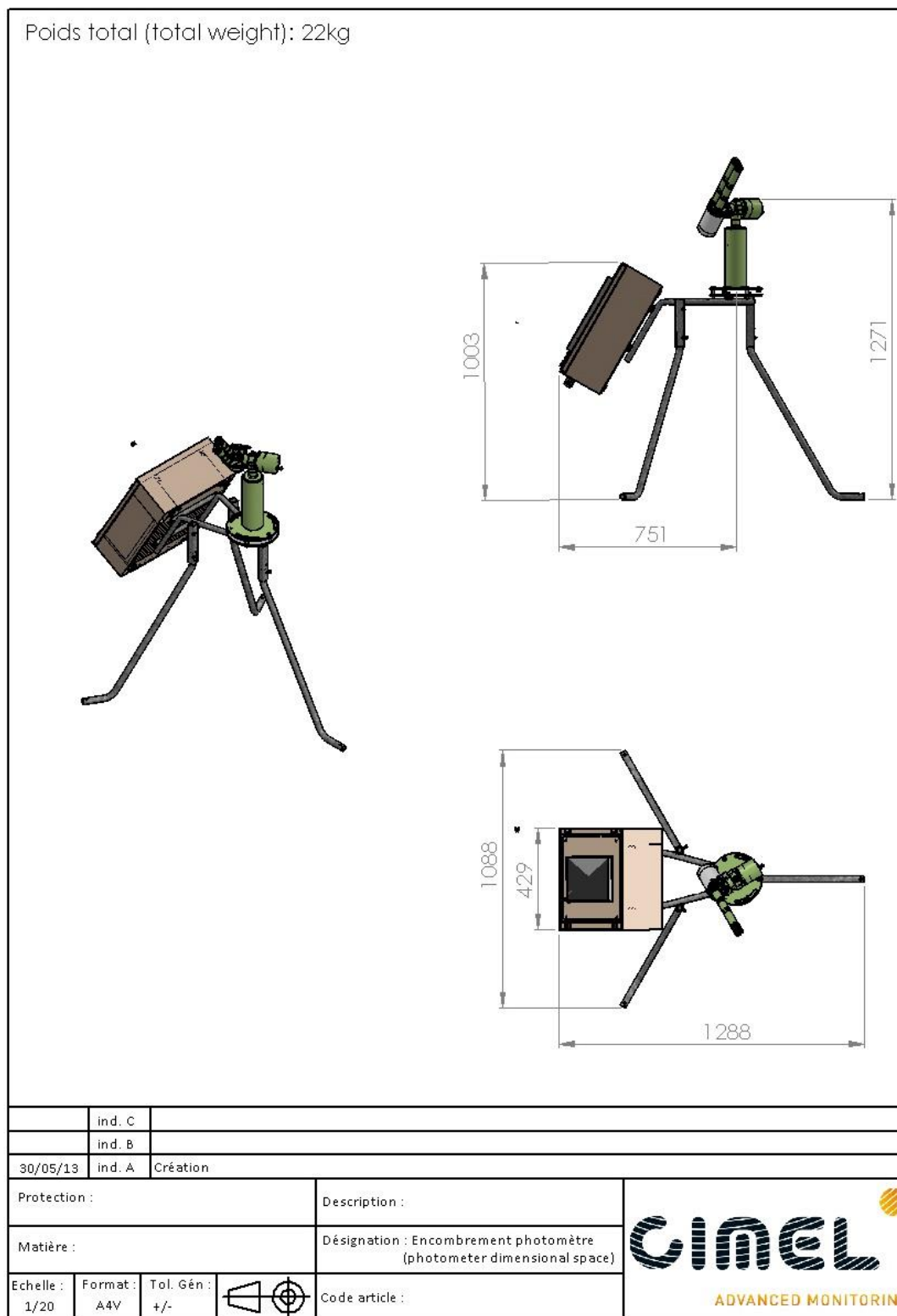
As soon as the wet sensor is activated, the photometer stops its measures and goes to the ORIG position to avoid water accumulation on the sensor head lenses and inside the collimator.

9 Technical specifications

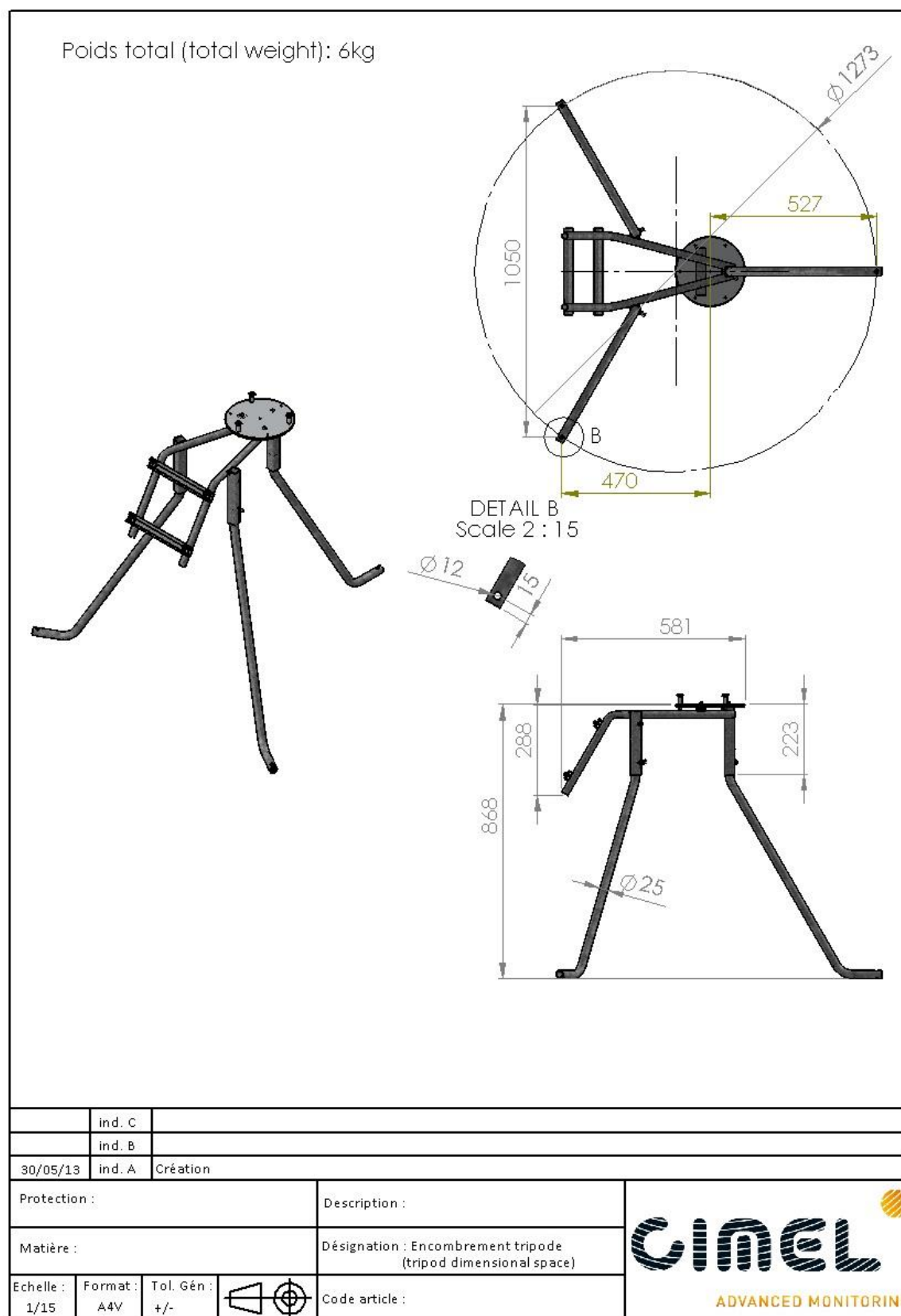
9.1. General

Specification	value
Irradiance precision	< 0.1%
Field of view	1.3°
Minimal scattering angle from the sun	2°
Spectral range	340 to 1640 nm
Optical filter drift	< 1% / year
Automated mount	Azimuth and zenith motors
Sky angular scanning	Whole sky : Azimuth: 0 – 360°
Mechanical precision spot	0.003°
Solar tracking precision	0.01°
Power consumption	< 2W
Interferential filter bandwidth	< 30 nm
Total weight without support	25 kg
Power supply	Autonomous through solar panel
Mode	Sun, Sky, Lunar
memory	32 GB on SD card
Solar and moon scanning	4 quadrant sensor
Temperature	-30 to 70° C
humidity	0 to 100 %
RS232 (up to 100 m cable)	9600 baud/s
Numeric count dynamic	0 to 2 097 152

9.2. Dimensional drawings

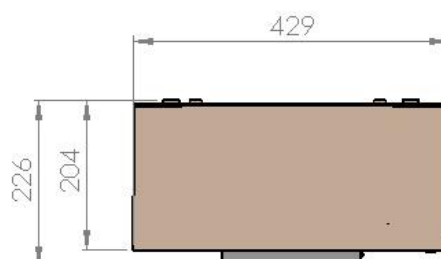
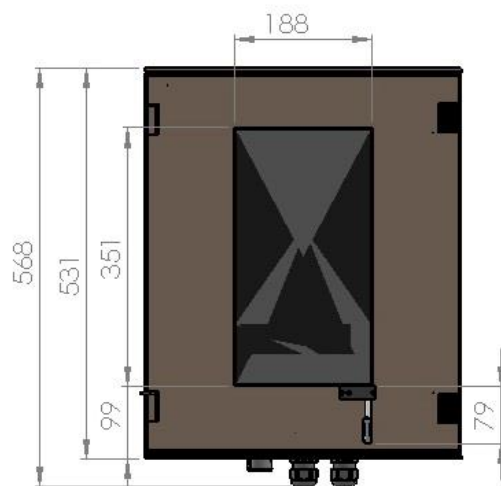
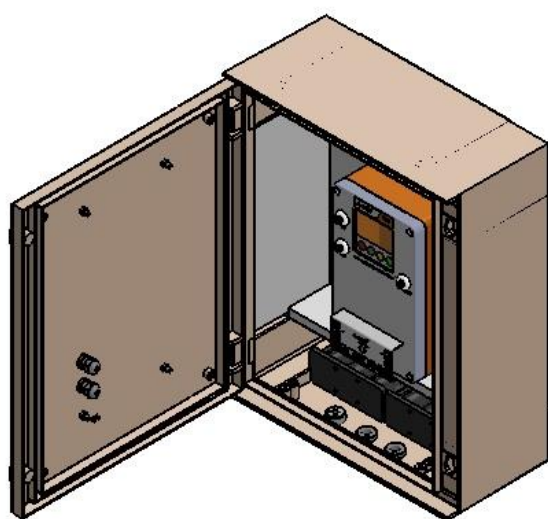


Revision 4.3 January 2018



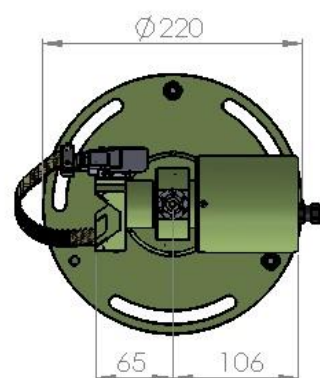
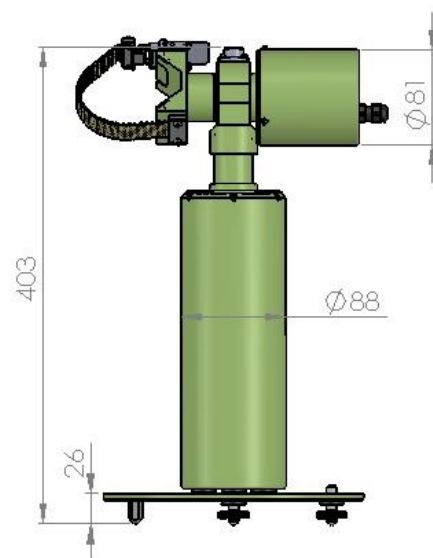
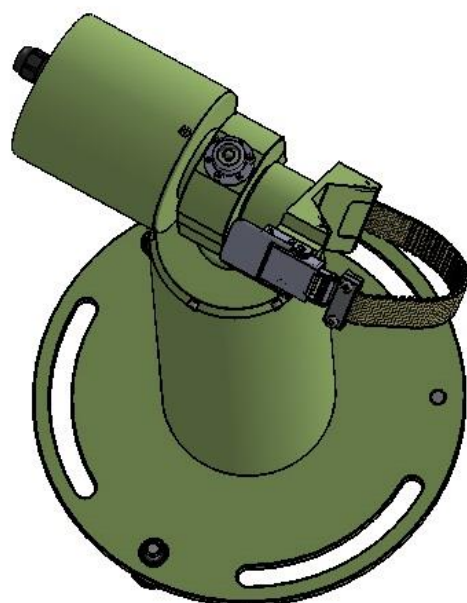
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Poids total (total weight): 8kg



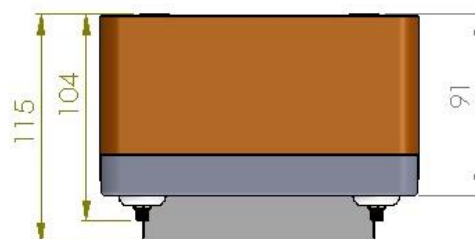
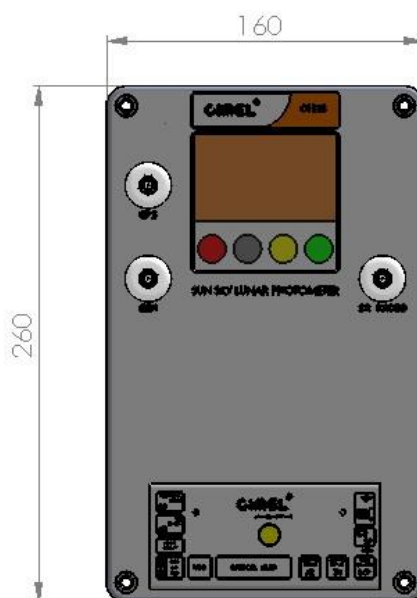
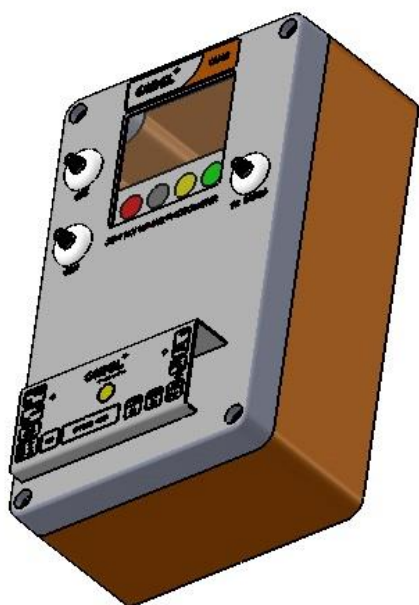
	Ind. C	
	Ind. B	
30/05/13	Ind. A	Création
Protection :		Description :
Matière :		Désignation : Encombrement boîtier (case dimensional space)
Echelle : 1/8	Format : A4V	Tol. Gén : +/-
		Code article :


Poids total (total weight): 6kg



	ind. C				
	ind. B				
30/05/13	ind. A	Création			
Protection :			Description :		
Matière :			Désignation : Encombrement robot (robot dimensional space)		
Echelle :	Format :	Tol. Gén :		Code article :	
1/15	A4V	+/-			

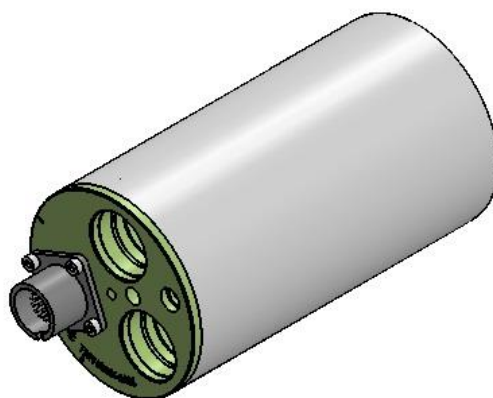
Poids total (total weight): 3 kg




	ind. C	
	ind. B	
30/05/13	ind. A	Création
Protection :		Description :
Matière :		Désignation : Encombrement unité acquisition (acquisition unit dimensional space)
Echelle :	Format :	Tol. Gén :
1/3	A4V	+/-
		Code article :
 ADVANCED MONITORING		

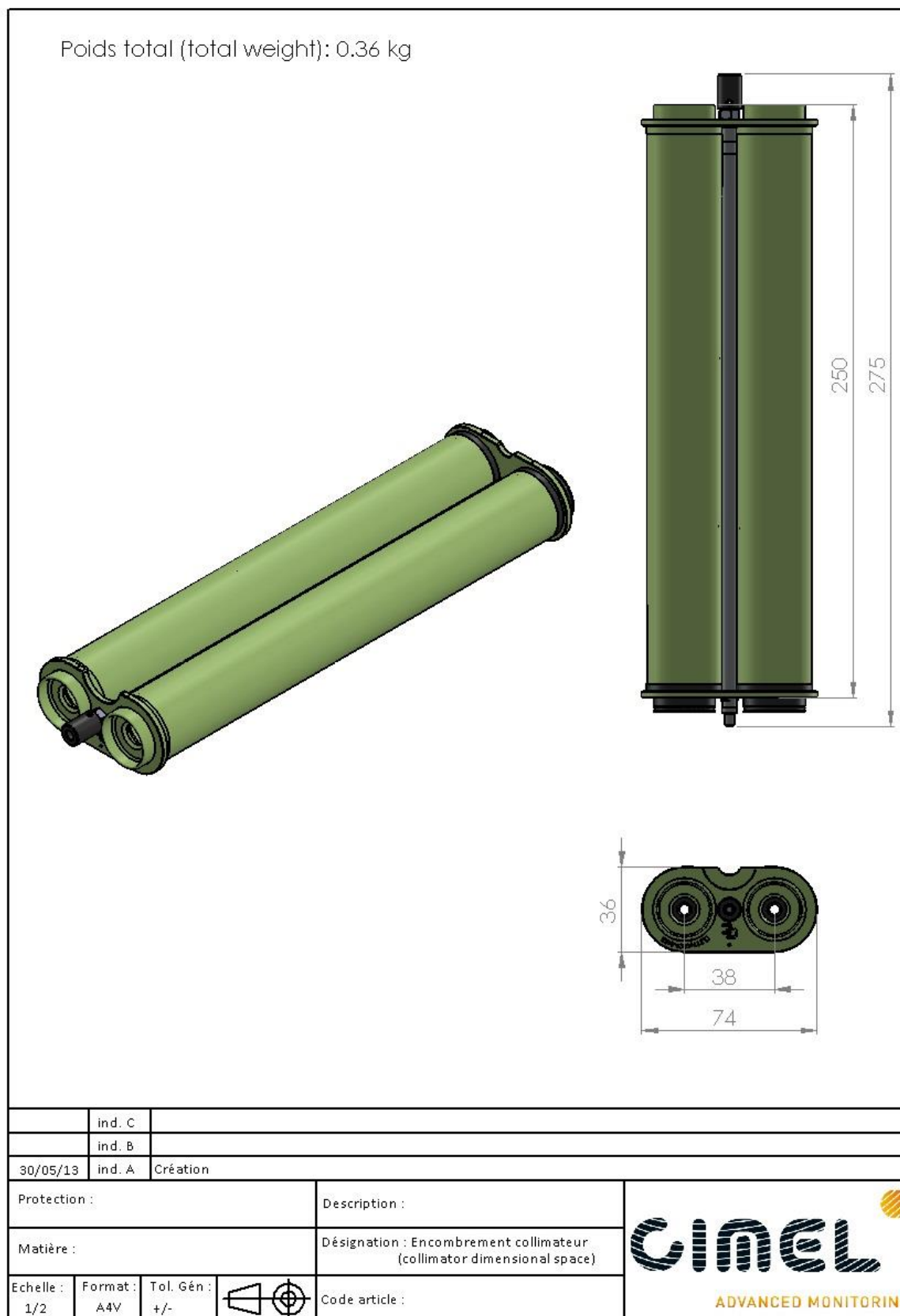
Revision 4.3 January 2018

Poids total (total weight): 1 kg



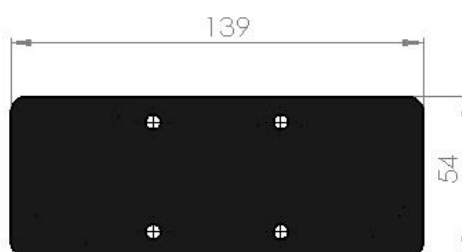
	ind. C	
	ind. B	
30/05/13	ind. A	Création
Protection :		Description :
Matière :		Désignation : Encombrement tête (head dimensional space)
Echelle : 1/2	Format : A4V	Tol. Gén : +/-
		Code article :
		


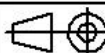
Revision 4.3 January 2018



Revision 4.3 January 2018

Poids total (total weight): 1.4 kg x 2



	ind. C				
	ind. B				
30/05/13	ind. A	Création			
Protection :		Description :			
Matière :		Désignation : Encombrement batterie (battery dimensional space)			
Echelle : 1/2	Format : A4V	Tol. Gén : +/-			

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10 After-Sales Service and Customer Relations

For any technical information about the instrument or for any issues please contact Cimel at:

Cimel Electronique S.A.S

172 rue de Charonne

75011 Paris

FRANCE

Phone: (+33) 143 487 933

Fax: (+33) 143 486 261

Email: support@cimel.fr

Cimel can use Skype and Team Viewer to provide technical support. When contacting us please indicate:

- The reference and the serial number of your product.
- Your email.
- Optional: Skype and/or Team Viewer address.

In term of technical support, Cimel policy is to diagnose issues using remote maintenance. It avoids a long period without the instrument running and it avoids sending back all the material to the factory in most of the cases.

Always contact technical support before sending back the photometer.

After an instrument failure, wait a diagnosis before making any intervention on it. Never try to replace a component by yourself without CIMEL approval.